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# USSR Report

EARTH SCIENCES

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8 July 1985

# USSR REPORT EARTH SCIENCES

## CONTENTS

### OCEANOGRAPHY

Space Photographs Confirm 40-Year-Old Hydrodynamics Discovery (N. Kirsanov; SOTSIALISTICHESKAYA INDUSTRIYA, 25 Apr 85).	1
Metrology and Oceanology Institutes' Underwater Acoustics R&D (A. Kasobrodov; VODNYI TRANSPORT, 27 Apr 85).....	3
Structure of Reykjanes Ridge Rift Zone and Icelandic Thermal Anomaly (I. M. Sborshchikov, M. V. Rudenko; GEOTEKTONIKA, No 2, Mar-Apr 85).....	5
Influence of Surface Films of Petroleum Products on Conditions for Absorption of Solar Radiation by Upper Water Layer (S. P. Malevskiy-Malevich, S. A. Baluyev; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 3, Mar 85).....	6
One Mechanism for Generation of Wave Disturbances in Spectra of Turbulent Flows Near Ocean Surface (V. L. Vlasov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 3, Mar 85).....	6
Use of Adjoint Equations in Problems of Evaluating State of Random Hydrodynamic Fields (G. I. Marchuk, Yu. N. Skiba, et al.; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 3, Mar 85).....	7
Natural Gas Anomaly in Bottom Waters of South China Sea (A. I. Obzhirov, V. I. Il'ichev, et al.; DOKLADY AKADEMII NAUK SSSR, No 5, Apr 85).....	8

Ultramicroscopic Study of Structure of Phosphorites From Sea of Japan Floor (G. N. Baturin, I. I. Bersenev, et al.; DOKLADY AKADEMII NAUK SSSR, No 5, Apr 85).....	9
Rip in White Sea (G. I. Barenblatt, I. A. Leykin, et al.; DOKLADY AKADEMII NAUK SSSR, No 6, Apr 85).....	10
Kuril-Aleutian Subduction (B. V. Baranov, A. S. Monin; DOKLADY AKADEMII NAUK SSSR, No 6, Apr 85).....	10
Plane Tsunami Wave Caused by Elastic Oscillations of Ocean Floor (N. A. Slezkin; DOKLADY AKADEMII NAUK SSSR, No 6, Apr 85).....	11
Geological-Geophysical and Gas-Biochemical Studies in Bering Sea (A. A. Geodekyan, Yu. P. Neprochnov, et al.; SOVETSKAYA GEOLOGIYA, No 3, Mar 85).....	12
Microstructural Analysis of Pacific Ocean and Indian Ocean Ultrabasites (S. A. Shcherbakov; IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA, No 3, Mar 85).....	12
Geochemistry of Manganese in Ocean (A. P. Lisitsyn, V. V. Gordeyev, et al.; IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA, No 3, Mar 85).....	13
Destruction of Density Jumps in Ocean by Turbulence (A. Yu. Benilov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	14
Study of Drift Currents in Initial Stage of Generation of Wind Waves by Laser Doppler Anemometer (V. G. Mikhalevich, K. V. Pokazeyev, et al.; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	15
Frequency of Recurrence and Critical Conditions for Generation of Langmuir Circulations (S. V. Ryanzhin, D. V. Mironov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	15
Parametric Description of Cold Film on Ocean Surface (V. N. Kudryavtsev, A. V. Solov'yev; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	16

Model Computations of Light Reflection From Sea Surface (K. S. Shifrin, R. G. Gardashov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	17
Method for Computing Evolution of Random Hydrodynamic Fields on Basis of Adjoint Equations (G. I. Marchuk, Yu. N. Skiba, et al.; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	18
Allowance for Differences in Ellipsoids and Geodetic Control Coordinate Systems in Determining Ship's Position Using Radio Navigation Systems (S. I. Kotyashkin; EKSPRESS-INFORMATSIYA. SERIYA: MORSKAYA GEOLOGIYA I GEOFIZIKA, No 3, 1985).....	18
Dynamic Theory of Polar Tide (S. M. Molodenskiy; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI, No 3, Mar 85).....	19
Sea Water Photoluminescence (D. N. Glebovskiy, A. L. Kirillov, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 3, Mar 85).....	20
Mineralogical-Geochemical Characteristics of Ferromanganese Formations in Arabian-Indian Ocean Ridge (Ye. F. Shnyukov, E. A. Yanchuk, et al.; DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI, No 3, Mar 85).....	21
Temporal Variations of $Rn^{222}$ Concentrations in Black Sea Coastal Zone (A. P. Arbuzova, G. F. Batrakov, et al.; DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI, No 3, Mar 85).....	21
Sea Surface Radio Emission at Wavelengths 0.86 and 1.3 cm Near Brewster Angle (V. D. Krotikov, V. N. Nikonov, et al.; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb-Mar 1985).....	22
Accuracy in Determining Velocity of Fluid Movement by Doppler Method (S. N. Gurbatov, A. N. Malakhov, et al.; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb-Mar 1985).....	23



Sixth All-Union Marine Geology School (A. A. Chistyakov, R. Ye. Krasovskaya; EKSPRESS- INFORMATSIYA. SERIYA: MORSKAYA GEOLOGIYA I GEOFIZIKA, No 2, 1985).....	24
Use of Stereographic Projection in Marine Geodesy (G. M. Folomkin; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA, No 1, Jan-Feb 85).....	24
Heat Flow Through Ocean Floor and Its Relationship to Litho- Sphere Structure and Thickness (A. M. Gorodnitskiy; BYULLETEN' MOSKOVSKOGO OBSHCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY, No 2, Mar-Apr 85).....	25
Density Characteristics of Asthenosphere in Atlantic Ocean (A. V. Ladynin, E. M. Litvinov, et al; BYULLETEN' MOSKOVSKOGO OBSHCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY, No 2, Mar-Apr 85).....	26
Influence of Underwater Volcanic Mountains of Atlantic on Microplankton Distribution (A. S. Lopukhin; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA, No 1, Jan 85).....	27

#### TERRESTRIAL GEOPHYSICS

Projects of the Computer Center of the Academy's Siberian Branch (Ye. Solomenko; PRAVDA, 8 Apr 85).....	28
Discovery in Earthquake Forecasting and Seismic Zoning Recorded (R. Akhmetov; BAKINSKIY RABOCHIY, 26 Apr 85).....	29
Aerospace Technology Determines Forest-Fire Danger (V. Vasil'yev; SOVETSKAYA MOLDAVIYA, 17 Apr 85).....	30
Tectonic Structure Features of Some Deep Faults in Atlantic and Pacific Oceans (According to Deep Seismic Sounding- Reflected Waves Method Data) (L. I. Kogan, L. P. Zonenshayn, et al.; GEOTEKTONIKA, No 2, Mar-Apr 85).....	31
Space Methods for Geological Research (V. A. Bush, V. N. Bryukhanov, et al.; SOVETSKAYA GEOLOGIYA, No 3, Mar 85).....	32

## PHYSICS OF ATMOSPHERE

Symposium on Luminescent Radiation Receivers and Converters (G. Khyutt; SOVETSKAYA ESTONIYA, 25 Apr 85).....	33
Mathematical Model of Global Processes in the Biosphere (V. Krapivin, Yu. Svirizhev; NTR: PROBLEM I RESHINYA, 2-16 Apr 85).....	34
More on Shock-Wave Studies With "Prognoz-10" Satellite (G. Lomanov; SOTSIALISTICHESKAYA INDUSTRIYA, 27 Apr 85).....	36
Functions of 'Prognoz-10--Intercosmos' Station Explained (B. Konovalov; IZVESTIYA, 27 Apr 85).....	37
'Prognoz-10--Intercosmos' Station Launched To Study Shock Waves (IZVESTIYA, 27 Apr 85).....	39
Institute Works on Modeling Thermonuclear Plasma Processes (D. Vatsek; KOMSOMOL'SKAYA PRAVDA, 27 Apr 85).....	40
Variability of Air Humidity Profiles Over Ocean Determined by Lidar Sounding (V. G. Borodin, O. A. Bukin, et al.; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 3, Mar 85).....	41
Use of Radar With Frequency Modulation for Studying Atmospheric Boundary Layer (V. R. Zhezherin, L. V. Knyazev; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 3, Mar 85).....	42
Additional Possibilities of Radiometer Azimuthal Method for Measuring Wind Velocity in Lower Thermosphere (R. D. Gaynutdinova, K. A. Karimov; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 3, Mar 85).....	43
Global Model of Transport of Pollutants in Atmosphere (V. V. Penenko, A. V. Panarin; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 3, Mar 85).....	43
Small-Scale Structure of Ionospheric F-Region (V. Ye. Zasenkov; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 3, Mar 85).....	44
Specifics of Laser Sounding of Atmosphere Along Horizontal and Slightly Slanting Paths Over Water Surface (A. I. Grishin, G. G. Matviyenko; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	45

Optical Stability, Atmospheric Transparency and Aerosol Absorption (G. Sh. Livshits; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	46
Propagation of Acoustic Pulse in Atmospheric Waveguide (S. N. Kulichkov, I. P. Chunchuzov, et al.; IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA, No 2, Feb 85).....	46
Approximate Method for Computing Wind Velocity in Atmosphere (L. A. Zhurbilo, V. I. Tsvetkov; VESTSI AKADEMII NAVUK BSSR: SERIYA FIZIKA-MATEMATYCHNYKH NAVUK, No 1, Jan-Feb 85).....	47
Clearing of Polydisperse Aqueous Aerosol by Laser Radiation Pulses (V. K. Pustovalov, I. A. Khorunzhiy; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 3, Mar 85).....	48
Radio Wave Scattering and Turbulence Intermittence in Atmosphere (A. S. Gurvich; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 2, Feb-Mar 1985).....	48
ARCTIC AND ANTARCTIC RESEARCH	
Conditions for Formation of Parageneses Containing Kyanite-Orthoclase in Region of Mount Provender and Pratt Peak (Shackleton Range, Antarctica) (V. S. Semenov; DOKLADY AKADEMII NAUK SSSR, No 5, Apr 85).....	50
Use of 'Omega' Radio Navigation System in Geophysical Work in Antarctica (S. I. Kalinskiy; EKSPRESS-INFORMATSIYA. SERIYA: MORSKAYA GEOLOGIYA I GEOFIZIKA, No 4, 1985).....	51
Highly Important Features of Regional Tectonics of Earth's Arctic Sector (V. P. Gavrilov; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA, No 1, Jan 85).....	51



## OCEANOGRAPHY

### SPACE PHOTOGRAPHS CONFIRM 40-YEAR-OLD HYDRODYNAMICS DISCOVERY

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 25 Apr 85 p 4

[Article by N. Kirsanov]

[Excerpt] Artificial satellites have unexpectedly confirmed a discovery by a Soviet scientist that was made on Earth.

Photographs of our planet which are taken from space are always impressive and sometimes puzzling. When cameras with high resolving power appeared not long ago on satellites, cloud clusters that were altogether unusual were suddenly discovered in photographs. They perplexed specialists at first. In some parts of the world, clouds formed in patterns of wedges, one after another, resembling children's drawings of Christmas trees. These patterns were thus called 'Christmas trees.'

Works by academician Vasiliiy Vladimorovich Shuleykin, an eminent Soviet scientist, which were done as far back as 40 years ago, helped to shed light on this phenomenon.

Soon after the war, Shuleykin, who was a leading specialist in hydrodynamics, studied the interaction of objects moving in water in direct proximity to each other. He succeeded in determining the following regularities. If two objects are moving along parallel courses, a force is created between these objects which tends to bring them closer together. If one of the objects is moving directly behind the other, a repelling force is created. The bodies do not affect each other only if they are moving in echelon at an angle of approximately 55 degrees. The force of interaction is proportional to the sizes of the bodies and inversely proportional to the distance separating them.

The angle of the vertex of a wedge formed by cranes in flight is thus... 110 degrees! It turns out that the same law applies to birds. Feathered travelers in the air instinctively select the optimal formation which enables them to fly with minimal expenditure of energy.

Let us now return to space. At the summits of mountains on islands in parts of the Indian and Pacific oceans, powerful air currents split into dense streams. They break up cloud cover into separate clouds and arrange them

one after another in the form of a wedge ~~with~~ an angle 100 degrees at the vertex -- strictly in accordance with V.V. Shuleykin's discovery. This is clearly visible in the enlarged section of a space photograph [which was given].

This story is by no means just a page from science history; it is directly relevant to the present day. Shuleykin's conclusions must be kept in mind by contemporary designers in hydroengineering and shipbuilding and by pneumatic-transport specialists. Taking this law into account permits savings of fuel and other resources.

FTD/SNAP

CSO: 1865/345

## METROLOGY AND OCEANOLOGY INSTITUTES' UNDERWATER ACOUSTICS R&D

Moscow VODNYY TRANSPORT in Russian 27 Apr 85 p 4

[Article by A. Kasobrodov]

[Abstract] The article is an interview with Doctor of Technical Sciences Aleksandr Markovich Trokhan, professor and head of a chair of instruction of the Moscow Physical-Technical Institute, deputy director of the USSR State Standards Committee's All-Union Scientific Research Institute of Physical-Technical and Radio Measurements (VNIIFTRI), and a leading specialist on underwater acoustics.

Trokhan comments on acoustical methods and equipment which are being used in oceanology and offshore mineral prospecting. An extensive program of underwater-acoustics research and development of measuring equipment for this purpose is said to be under way at VNIIFTRI. Trokhan relates that the institute's scientists take part regularly in expeditions on the scientific research ship "Akademik Mstislav Keldysh". They test new acoustical instruments and do research with scientists of the Institute of Oceanology. This joint work includes studies of characteristics of the ocean's surface and studies of the structure of the surface layer of the ocean floor using acoustic waves. The ocean's biological productivity is evaluated by the method of studying acoustic waves scattered by sea creatures, and dynamic processes in the ocean are investigated by studying noises. Scientists of VNIIFTRI work on perfecting methods for such studies.

Trokhan also comments on progress in standardizing technology for oceanographic measurements and expanding its capabilities. Thousands of scientists in diverse specialties are said to be working on development of equipment for new types of measurements, including qualitatively new computerized instruments. Development of uniform codes and signals and of optimal interface components for measuring equipment and computer technology is said to be a key task in this connection.

Trokhan comments in conclusion on a so-called acoustic tomography method which has been proposed for oceanographic studies. Systems based on this method would alternately emit and receive acoustic pulses. They would be installed in a fairly rigid pattern around the perimeter of an ocean. Signals received would yield information on the marine environment. Trokhan says that a group

at the oceanology institute is making extensive studies of this method. Its applications would include weather and earthquake forecasting, prospecting of offshore mineral resources, routine monitoring of oceanographic parameters, and studies of the water's biological activeness.

FTD/SNAP

CSO: 1865/345

STRUCTURE OF REYKJANES RIDGE RIFT ZONE AND ICELANDIC THERMAL ANOMALY

Moscow GEOTEKTONIKA in Russian No 2, Mar-Apr 85  
(manuscript received 21 Nov 83) pp 88-103

SBORSHCHIKOV, I. M. and RUDENKO, M. V., Oceanology Institute  
imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] An expedition of the Oceanology Institute was carried out in the summer of 1982 with the ships "Akademik Mstislav Kel'dysh" and "Rift," assisted by two "Paysis" manned submersibles, for studying the rift zone of Reykjanes Ridge. The objective of this expedition was a detailed study of the internal structure of the rift, magmatism, manifestations of hydrothermal activity and the distribution and composition of sediments. First the article describes general structural features, accompanied by a structural map of the ridge area. The structure of the axial part of the ridge (in the neighborhood of 58°N) is then discussed in detail (Fig. 2 shows the structure of the axial zone of the ridge; Fig. 3 shows three structural profiles through the rift zone; Fig. 4 is a block diagram of the rift valley; Fig. 5 illustrates some profiles obtained during "Paysis" dives). The characteristics of magmatism in the area are analyzed. Significant data on the development of the Reykjanes rift zone and the Icelandic "hot point" are presented (Fig. 7 is a diagram of the structure of the Reykjanes axial zone; Fig. 8 is a diagram of development of the Reykjanes rift zone, based on data on linear magnetic anomalies). Particular attention is given to the unusual width of the rift valley with the volcanic ridges oriented along its bottom. There are many indicators of extremely intense volcanism in this region. Evidently there is a quite extensive magma hearth beneath the axial zone. With the full range of available data taken into account it is concluded that an underflow of matter from the Iceland region exerts a significant influence on the development of the Reykjanes structure. Figures 8; references 36: 7 Russian, 29 Western.  
[309-5303]



# INFLUENCE OF SURFACE FILMS OF PETROLEUM PRODUCTS ON CONDITIONS FOR ABSORPTION OF SOLAR RADIATION BY UPPER WATER LAYER

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 21, No 3, Mar 85 (manuscript received 24 May 82) pp 328-330

MALEVSKIY-MALEVICH, S. P. and BALUYEV, S. A., Main Geophysical Observatory

[Abstract] The authors made laboratory and in situ studies of the effect of films of petroleum products on the water reflection and absorption of total solar radiation. Emphasis was on the overall effect of changes of radiation penetrating into the water at some small depth under the influence of films present on the surface. Laboratory work was done using an apparatus consisting of a radiation source (lamp) and radiation detector (underwater pyranometer). After conducting an experiment with pure water, a stipulated quantity of pollutant was applied to the water surface and the radiation flux transmitted through the system was measured under the new conditions. The ratio of the fluxes for pure water ( $Q_0$ ) and water with petroleum pollution ( $Q_{poll}$ ) was determined as a function of the thickness  $h$  of films of different types of petroleum products. Film thicknesses of 5, 10, 20, 40, 60, 80 and 100  $\mu\text{m}$  were studied. The experiments were made only with normal incidence of the radiation flux on the water surface. It was found, for example, that the presence of even thick films of diesel fuel and some light types of petroleum exerts virtually no change on the quantity of penetrating radiation. Data are also given on the relative change of albedo for pure and petroleum-polluted water under the influence of films of different petroleum products for different solar altitudes. It is shown that the  $A_0/A_{poll}$  ratio has virtually no dependence on solar altitude and there is a relatively weak change in albedo under the influence of the films. It now seems clear that the influence of films of petroleum products on thermal interaction between the ocean and the atmosphere is determined almost entirely by evaporation changes. Figures 3; references: 6 Russian.  
[318-5303]

UDC 551.551.2

# ONE MECHANISM FOR GENERATION OF WAVE DISTURBANCES IN SPECTRA OF TURBULENT FLOWS NEAR OCEAN SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 21, No 3, Mar 85 (manuscript received 17 Jun 83) pp 285-294

VLASOV, V. L., Oceanology Institute, USSR Academy of Sciences

[Abstract] A mechanism of the generation of wave disturbances in the spectra of turbulent flows of mass and energy near the ocean surface is proposed. The postulated mechanism is governed by a periodic time shift

(phase modulation) of turbulent fluctuations of the velocity of particles of the medium and a passive admixture during contact flow of a turbulent shear current or the wind over the long-wave components of sea waves. The theoretical examination of this mechanism made it possible to derive an expression for the cospectrum distorted by wave disturbances. This expression was derived under the general assumptions that turbulent fluctuations constitute a stationary (in the broad sense) random process with a spectrum of arbitrary form and that the superpositioning of fluctuations of sea surface long-wave components is a narrow-band normal random process. Despite substantial wave distortions of the cospectrum the intensity of the turbulent flow in this mechanism is invariant. The theoretical conclusions are compared with experimental data. The overall picture of wave distortions of the spectra of turbulent flows near the ocean surface, in addition to the described mechanism, involves such factors as their measurement from a swaying ship, orbital motions of particles near the wave-covered interface, fluctuations of the mean profile of velocity of the turbulent shear current and the phase modulation associated with this flow, as well as the collapse of turbulent eddies on short-wave roughnesses of the sea surface or steep waves. Figures 3; references 15: 14 Russian, 1 Western.  
[318-5303]

UDC 532.51:551.465:551.513

# USE OF ADJOINT EQUATIONS IN PROBLEMS OF EVALUATING STATE OF RANDOM HYDRODYNAMIC FIELDS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 21, No 3, Mar 85 (manuscript received 27 Apr 83) pp 227-235

MARCHUK, G. I., SKIBA, Yu. N. and PROTSENKO, I. G., Computational Mathematics Section, USSR Academy of Sciences; Computer Center, Siberian Department, USSR Academy of Sciences; Marine Hydrophysics Institute, Ukrainian Academy of Sciences

[Abstract] This is essentially a continuation of an article by the authors in the preceding number of this journal (IZV. AN. SSSR: FAO, Vol 21, No 2, pp 115-122, 1985). In that paper they discussed methods for applying a stochastic-dynamic model and proposed a method for computing the first two moment equations for random hydrodynamic fields based on the hypothesis of neglecting of higher moments. The use of adjoint equations made it possible to develop an explicit method for computing the mean values and covariation functions of random fields close in their properties (with a small Courant number) to the implicit Crank-Nicholson method. Proceeding on this basis, the authors now examine the possibilities of applying this method for solving nonlinear problems, give a comparison with the Monte-Carlo method and discuss the assimilation of measurement data on the basis of filtering theory. The moment equations are closed by neglecting the third and higher central moments. Recurrent formulas are derived for computing the mean values and covariation functions in the example of a unidimensional nonlinear equation

for evolution of the velocity field. This involves use of solutions of definitely formulated adjoint problems and their properties. Use of the Kalman filter is discussed and two strategies for assimilation of measurements are analyzed. Figures 4; references 7: 4 Russian, 3 Western.  
[318-5303]

UDC 550.84

#### NATURAL GAS ANOMALY IN BOTTOM WATERS OF SOUTH CHINA SEA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 281, No 5, Apr 85  
(manuscript received 1 Aug 84) pp 1206-1209

OBZHIROV, A. I., IL'ICHEV, V. I., academician, and KULINICH, R. G., Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok

[Abstract] Natural gases in bottom waters were investigated on several cruises in the southwestern part of the South China Sea. Samples of water were taken with a BM-48 bathometer at stations 1 m from the bottom for the study of natural gases in bottom waters. In each case 500 ml of water were transferred from the bathometer into a vacuum apparatus for sampling the gas; the remaining 500 ml were used for hydrochemical measurements. Extraction of gas and its analysis were accomplished directly on board. An LKhM-8-MD chromatograph was used in determining oxygen in combination with argon, nitrogen, carbon dioxide, methane and heavy hydrocarbons; hydrogen and helium were determined using a "Gazokhrom" chromatograph. A map of the research region accompanies the text. About 200 water samples were taken for studying natural gases in 1981-1983. Sampling depths varied from 20 to 2,000 m. The principal result of the work was the discovery of a quite narrow zone with an increased content of methane, hydrogen and carbon dioxide in bottom waters in the southwestern South China Sea. This anomalous zone extended in a meridional direction and was associated with the edge of the shelf. Its width does not exceed 10 miles and morphologically it is centered on the 200-m isobath. Two profiles were run across the anomalous zone. Each of the profiles is discussed in detail. The presence of heavy hydrocarbons in the anomaly zone gives basis for postulating the presence of petroleum hydrocarbons in the sediments. The natural gases detected in the bottom zone made it possible to trace a tectonically active zone which passes along the boundary of the shelf and the bottom slope of the South China Sea for a distance of 180 miles. The gas composition varied along the strike of the zone, which is attributable to the change in the depth of penetration of faults and a decrease in tectonic activity to the north and south. The traced zone must be taken into account in reconnaissance work for petroleum and gas as a factor favoring the generation of hydrocarbons and their migration. The natural gases in bottom waters and certain hydrochemical parameters can be used as indicators in geological mapping. Figures 3; references 8: 7 Russian, 1 Western.  
[348-5303]

## ULTRAMICROSCOPIC STUDY OF STRUCTURE OF PHOSPHORITES FROM SEA OF JAPAN FLOOR

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 281, No 5, Apr 85

(manuscript received 21 May 84) pp 1169-1172

BATURIN, G. N., BERSENEV, I. I., GUSEV, V. V., LELIKOV, Ye. P., SHEVCHENKO, A. Ya. and SHKOL'NIK, E. L., Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow; Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok

[Abstract] Phosphorites, which occur extensively on the underwater margins of the continents and on seamounts, have been discovered in recent years in the Sea of Okhotsk and in the Sea of Japan. In the Sea of Japan phosphorites are found primarily in large seamounts. The following varieties of phosphorites and phosphatic rocks have now been found in the Sea of Japan: phosphatic nodules, lithified solid phosphorites, unconsolidated slightly lithified phosphorites and phosphatized psephitic-psammitic rocks. The article gives the results of study of ultramicroscopic structure of typical phosphorite samples from the Sea of Japan from the Yamato and East Korean Rises dredged from the floor during expeditions undertaken by the Pacific Ocean Oceanological Institute. Ten to twelve specimens of phosphorite nodules and the same number of specimens of lithified solid phosphorites were prepared for electron microscope study. The nodular phosphorites from the Yamato Rise consist primarily of calcium phosphate, including numerous phosphatized organic remains; phosphatic components constitute less than 10% of the mass. The solid lithified phosphorites from the East Korean Rise are fragments of massive, thin-layered, sometimes brecciated rocks, also consisting primarily of calcium phosphate; the nonphosphatic material, amounting to 15-30%, is similar to that in nodular phosphorites. Electron microscope and petrographic studies give evidence of the nature of the initial substrate in which these phosphorites were formed. This was probably clayey-diatomaceous oozes, typical for zones of both recent and Late Quaternary phosphorite formation in the ocean. Micropaleontological studies suggest that their age is Middle to Late Miocene. In the Miocene the rises in the Sea of Japan were banks in extremely shallow water; some were possibly islands. The upwellings usually existing near such formations favored a high biological productivity of the waters, and as a result, considerable biosedimentation of phosphorus. This gave rise to increased phosphorus concentrations in the ooze waters and this caused formation of phosphorites. Figures 2; references: 8 Russian.

[348-5303]



## RIP IN WHITE SEA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 281, No 6, Apr 85  
(manuscript received 14 Aug 84) pp 1435-1439

BARENBLATT, G. I., LEYKIN, I. A., KAZ'MIN, A. S., KOZLOV, V. A.,  
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[Abstract] In the summer of 1983, on an expedition aboard the research ship "Shel'f" in the White Sea, where rips are frequently observed, specialists for the first time carried out a thorough study of the rip phenomenon, including measurements of the tidal current, bottom relief and sea waves. This article gives observational data confirming the relationship between rips and the tidal current and a qualitative physical model of a rip is presented. The rip was studied in a shallow-water (mean depth about 20 m) strait with well-expressed semidiurnal tides. Most of the observations were made near an elongated (about 4 km in length) underwater ridge with a depth of about 10 m and a width from tens to hundreds of meters, almost perpendicular to the direction of the tidal current. In 10 days a study was made of 18 rips when the wind was calm and sea waves were up to class 4. The rip observed near the underwater ridge was of the frontal type, characterized by the periodic appearance and disappearance of sharply bounded regions of quiet and disturbed sea surface. The observed phenomena are described in detail. Other types of rips are also discussed. The observed rips were invariably associated with bottom relief--bottom rises or depressions, but also with a fast current, and therefore correspond to the tide phases. When a fast current flows around an underwater ridge a strong horizontal nonuniformity of the flow arises which generates a system of specific surface waves which can be caused both by transformation of the wind waves in the counter horizontally nonuniform current and the formation of waves on the free surface during flow around an underwater obstacle. Figures 4; references 13: 10 Russian, 3 Western.  
[350-5303]

UDC 550.36:551.2

## KURIL-ALEUTIAN SUBDUCTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 281, No 6, Apr 85  
(manuscript received 22 Jun 84) pp 1328-1331

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[Abstract] Subduction has a great many indicators in the relief, in seismic profiling, in gravity anomalies, in the geothermal flow, in seismics and in



geochemical zonality. Nevertheless, there are still opponents of the subduction concept. One of the direct proofs of subduction is the interpretation of earthquake mechanisms in zones of island arcs, clearly demonstrated in the example of the Kuril-Kamchatka and Komandorskiye Islands-Aleutian Islands island arcs, forming an approximately right angle, along whose diagonal the Pacific Ocean plate is moving toward the northwest. Foci of strong earthquakes are situated in the zones of the Kuril-Kamchatka and Aleutian arcs. At the foci of strong earthquakes the axes of compressional stresses in general are directed to the northwest (so that they are perpendicular to the Kuril-Kamchatka arc and the western part of the Aleutian arc, but with movement along the latter to the west, as a result of its curvature, the angle formed with it by compressional stresses decreases) and a unified system of compressional stresses is formed at the boundary between the Pacific Ocean plate and the system of island arcs. There are complications to this picture which are emphasized strongly by the opponents of subduction. Point-by-point the different arguments of these opponents are refuted and it is clearly demonstrated that the geodynamics of the Kuril-Kamchatka and Komandorskiye Islands-Aleutian Islands arcs, in all its details, can be explained only on the basis of subduction. Figures 1; references 14: 7 Russian, 7 Western. [350-5303]

UDC 551.465.11

#### PLANE TSUNAMI WAVE CAUSED BY ELASTIC OSCILLATIONS OF OCEAN FLOOR

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 281, No 6, Apr 85  
(manuscript received 27 Dec 84) pp 1340-1344

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[Abstract] Although one approach in theoretical study of tsunami waves is based on a determination of oscillations of the elastic half-space covered by a layer of incompressible heavy fluid, it has received much less attention than other approaches in which the elastic properties of the ocean floor are not taken into account, it being suggested that a tsunami wave propagating over enormous distances must be sought amidst waves of the resonance type. Mathematically waves of the resonance type are related to the real roots of the dispersion equation, but the proponents of this approach have never given this equation a specific form. The pertinent dispersion equation is derived and validated in this article in the simplest case of plane waves. The equation is used in determining the velocity of tsunami wave propagation under specific circumstances. The approximate description of surface waves of a heavy fluid (in which the continuity equation in Lagrangian variables is used) is not adequate for this purpose; Eulerian variables must be used for this purpose because the A. I. Nekrasov precise theory of plane surface waves of a heavy incompressible fluid is based on use of such variables. Tables 2; references: 4 Russian. [350-5303]

## GEOLOGICAL-GEOPHYSICAL AND GAS-BIOCHEMICAL STUDIES IN BERING SEA

Moscow SOVETSKAYA GEOLOGIYA in Russian No 3, Mar 85 pp 84-90

GEODEKYAN, A. A., NEPROCHNOV, Yu. P., SEDOV, V. V., MERKLIN, L. R. and TROTSYUK, V. Ya., Oceanology Institute, USSR Academy of Sciences

[Abstract] The exploration of the Bering Sea carried out by Soviet and American specialists during the last 15 years is reviewed. In the summer of 1982, during the 23d cruise of the "Dmitriy Mendeleyev," workres of the Oceanology Institute carried out geological-geophysical and gas-biochemical research on the Bering Sea. With previous work taken into account, the principal objects of expeditionary research were the Navarin Basin and Shirshov Ridge. Several profiles were run through the Aleutian and Komandorskaya Basins. Three main types of research were conducted: reconnaissance geophysical survey, occupation of stations along the track and multiple types of research in test ranges. A reconnaissance survey included echo sounding, magnetometry and continuous seismic profiling. Work at stations included the taking of bottom samples with corers and dredges for subsequent lithological, stratigraphic and geochemical analyses, taking of water samples with bathometers for determining the content of suspended matter and use of special instruments for taking samples from standard horizons for analysis of gas microconcentrations, as well as geothermal measurements. In the test ranges there was seismic profiling by the reflected waves-deep seismic sounding method and station biogeochemical and geophysical research, including deep seismic sounding, using bottom seismographs and powerful pneumatic sound sources. Most of the geophysical and geological-geochemical work was concentrated in test range 1, measuring 180 x 72 miles (~44,300 km<sup>2</sup>). Gas-biogeochemical studies revealed the presence of an extensive (100 x 20 km) anomalous region extending from east to west in the central part of the test range, interpreted as a focus of petroleum and gas formation. Similar data were also obtained in other sectors of the Bering Sea floor. Figures 2; references 13: 5 Russian, 8 Western.

[315-5303]

## MICROSTRUCTURAL ANALYSIS OF PACIFIC OCEAN AND INDIAN OCEAN ULTRABASITES

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian No 3, Mar 85 (manuscript received 4 Jul 83) pp 54-65

SHCHERBAKOV, S. A., Geology Institute, USSR Academy of Sciences, Moscow

[Abstract] Extremely few microstructural studies of oceanic ultrabasites have been made; not more than 10 such samples have been recovered from the

ocean floor. In order to detect high-temperature plastic deformations of such ultrabasites the author studied 6 samples recovered from the Pacific and Indian Oceans. These ultrabasites fall into two groups which differ with respect to microstructure. Those with spinel lherzolites and harzburgites are characterized by deformational ("tectonite") structure. Those in the second group, containing plagioclase (troctolite and plagioclase lherzolite) are characterized by cumulative structures. The first group therefore consists of tectonized rocks with structures caused by intensive high-temperature plastic deformations of material in a solid state. In the cumulative type the traces of plastic deformation are manifested weakly or not at all. Despite the small number of samples investigated, it is concluded that in the course of plastic deformations there was not only a restructuring of the ultrabasites, but also their mineralogical transformation. The high-temperature deformations which the ultrabasites underwent with their advance toward the earth's surface, favoring a redistribution of the rock components and their segregation into independent mineral phases, led to the solid-phase differentiation of upper mantle matter and laid the groundwork for the partial melting and expulsion of the easily molten phases. It appears that the seismic anisotropy of the oceanic upper mantle is a consequence of the lateral plastic flow of matter transpiring in it in the direction of spreading. Figures 5; tables 1; references 20: 10 Russian, 10 Western.

[312-5303]

UDC 546.711/717:551.463

#### GEOCHEMISTRY OF MANGANESE IN OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOLOGICHESKAYA in Russian  
No 3, Mar 85 (manuscript received 23 May 83) pp 3-29

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[Abstract] Fifty-two Soviet and foreign sources were exploited in preparing this in-depth analysis of the geochemistry of manganese in the ocean. The material is organized into these sections: Regularities in entry of Mn into the ocean. Exogenous and endogenous Mn; Regularities in Mn distribution in ocean: suspended matter, plankton, solutions. Mn flow in ocean. Biodifferentiation and zonality; Regularities in Mn distribution in ocean bottom sediments. Forms, zonality. A whole series of important conclusions is drawn on the basis of these generalized materials. The textual material is accompanied by a series of significant charts and diagrams. Figure 1 shows the receipt of endogenous Mn and Fe from the ocean floor and ferromanganese "volcano" on the ocean floor; Fig. 2--quantitative relationship between receipt of endogenous  $^3\text{He}$  and endogenous Mn in bottom waters of active ridges in ocean and Red Sea; Fig. 3--vertical distribution of  $\text{Mn}_{\text{sus}}$  and  $\text{Mn}_{\text{dis}}$  and forms of Mn in solution and suspension in waters of Pacific and Indian Oceans and Sea of Okhotsk; Fig. 4--Mn distribution in bottom sediments

of seas and oceans; Fig. 5--distribution of metal-bearing sediments and indicators of receipt of endogenous material on world ocean floor; Fig. 6--zonality of annual absorption of Mn by phytoplankton from solutions in comparison with zonality of primary production of phytoplankton; Fig. 7--absolute Mn masses and Fe/Mn ratio in ocean sediments. Equally informative tables also accompany the analysis. Figures 7; tables 3; references 52: 34 Russian, 18 Western.  
[312-5303]

UDC 551.465.15

#### DESTRUCTION OF DENSITY JUMPS IN OCEAN BY TURBULENCE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA  
in Russian Vol 21, No 2, Feb 85 (manuscript received 28 Jun 83)  
pp 197-207

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[Abstract] Until now little attention has been given to study of formation of the vertical layered structure in the ocean which can be generated by turbulent mixing resulting due to loss of stability of shear currents, collapse of internal waves or convective movements caused by the difference in the coefficients of molecular transport of heat and salt. For this reason a study was made of the principal properties of turbulence in the mixing layers which can develop in the neighborhood of jumps in hydrophysical fields in the case of a stepped vertical microstructure. Specifically, a single burst of turbulence is examined, with the appearance of a mixed layer in the neighborhood of the jump. In such a problem it is admissible to idealize the initial density stratification in the form of a two-layer (but mixing) fluid. An additional simplifying assumption is the condition of statistical homogeneity of the random fields of velocity, temperature and salinity in the horizontal planes. A system of equations from semiempirical turbulence theory is used in describing the dynamics of turbulence and the processes of vertical turbulent transport of momentum, heat and salt in the mixing layer. On this basis the author developed a classification of stability and instability of background conditions relative to turbulent disturbances. The relationships between the thickness of the mixing layer and background conditions and the turbulence level in it were determined. Laws of generation and degeneration of turbulence in the mixing layer were formulated for different background stratification conditions. The conclusions from theory are compared with data from laboratory and in situ measurements. Figures 2; tables 1; references 16: 13 Russian, 3 Western.  
[317-5303]



## STUDY OF DRIFT CURRENTS IN INITIAL STAGE OF GENERATION OF WIND WAVES BY LASER DOPPLER ANEMOMETER

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 21, No 2, Feb 85 (manuscript received 6 Jun 83) pp 191-196

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[Abstract] Measurements of the profiles of a drift current in the initial stage of generation of wind waves were made using a laser Doppler velocity meter under conditions of calm water, accompanying and counter currents and on this basis an evaluation is made of the flux of momentum imparted to waves and currents. The use of this laser instrument ensured a high temporal and spatial resolution, with a high accuracy making it possible to measure mean and instantaneous velocity in the thin surface layer. These fundamental measurements were supplemented by measurements of the following parameters: water surface rise, mean wind velocity, mean velocity of counter and accompanying currents. The experiment was carried out in a flume 6.7 m long, 0.4 m high and 0.2 m wide. The water depth was 19 cm and the fetches were 1.5 and 3.0 m. About 50 drift current profiles were obtained with corresponding data on wind velocity, the external current and the state of waves. A block diagram of the experimental apparatus is given; wind velocities varying from 2.0 to 4.6 m/sec were measured. These measurements revealed a redistribution of the flux of momentum received from the wind between waves and the current with a change in wind velocity. The reasons for this redistribution of the flux of momentum are discussed. Figures 3; tables 1; references 14: 7 Russian, 7 Western.

[317-5303]

## FREQUENCY OF RECURRENCE AND CRITICAL CONDITIONS FOR GENERATION OF LANGMUIR CIRCULATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 21, No 2, Feb 85 (manuscript received 17 Apr 83) pp 184-190

RYANZHIN, S. V. and MIRONOV, D. V., Limnology Institute, USSR Academy of Sciences; Leningrad State University

[Abstract] Langmuir circulations constitute a phenomenon which occurs widely in seas and lakes. Accordingly, a study was made of the frequencies of recurrence and critical conditions for the appearance of Langmuir circulations with different wind velocities, shearing stresses at the water-air interface and nature of hydrostatic stability in the upper layers of a lake.



Studies by the authors in Lake Ladoga and data in the literature are generalized. It was found that the frequencies of recurrence of circulations in lakes and seas are close, attaining values 0.36-0.67. The frequency of recurrence increases with an increase in the level of transfer of wind energy to the surface. A 100% probability of circulations is observed in a transient wind flow regime in the interval  $\tau \approx 0.15-0.25$  dyne/cm<sup>2</sup>. An intensification of hydrostatic stability shifts the boundary of 100% and 0 frequency of recurrence of circulations to the right. The  $\tau_{acr}$  value critical

for the appearance of Langmuir circulations also increases with an intensification of hydrostatic stability (square of Brunt-Väisälä frequency  $N_1^2$ ), attributable to additional expenditures on overcoming buoyancy forces. The dependence of  $\tau_{acr}$  on  $N_1^2$  was determined. Figures 3; references 11:

9 Russian, 2 Western.  
[317-5303]

UDC 551.465.152:551.465.66

#### PARAMETRIC DESCRIPTION OF COLD FILM ON OCEAN SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 21, No 2, Feb 85 (manuscript received 22 Mar 83) pp 177-183

KUDRYAVTSEV, V. N. and SOLOV'YEV, A. V., Marine Hydrophysics Institute, Ukrainian Academy of Sciences; Atmospheric Physics Institute, USSR Academy of Sciences

[Abstract] In the molecular sublayer beneath the free ocean surface there is a sublayer of molecular thermal conductivity and a viscous sublayer. The temperature drop in the sublayer of molecular thermal conductivity is called the "cold film." As the accuracy in IR methods for studying the ocean surface increases it is essential to make allowance for the temperature drop in the cold film. The authors suggest a parametric description of the principal characteristics of the cold film as an effective approach in solving this problem. This requires a full comprehension of free and forced convection in the molecular sublayer of cooling water. A model is formulated in which the following phenomena play a role. The main part of the molecular sublayer under the free surface is in a laminar state, except for narrow moving convergence zones in which cooled water is carried from the limits of the molecular sublayer into the deeper part of the ocean as well as brief local surges of water from the limits of the molecular sublayer by means of eddies or discrete convective elements. A change in the convection regime in the molecular sublayer occurs in a jump with transition through the critical value of the surface Richardson number. The mean time of presence of liquid water particles in contact with the water surface is equal to the time scale of convection (free or forced), depending on the value of the surface Richardson number. In the model nonstationarity is caused by

destruction of the sublayers either by dynamic instability of the viscous sublayer or by the convective instability of the sublayer of molecular thermal conductivity. With all these factors and others taken into account a universal parametric description of the temperature drop in the cold film is proposed which is compared with data from in situ experiments. Figures 1; references 16: 9 Russian, 7 Western.

[317-5303]

UDC 551.521.14

#### MODEL COMPUTATIONS OF LIGHT REFLECTION FROM SEA SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 21, No 2, Feb 85 (manuscript received 1 Nov 83, after revision 23 May 84) pp 162-169

SHIFRIN, K. S. and GARDASHOV, R. G., Oceanology Institute, USSR Academy of Sciences

[Abstract] The method of stochastically distributed surfaces is used extensively in marine optics in computing the reflection of light from the wave-covered sea surface; surface brightness is determined through the Fresnel reflection coefficient for which there is a mirror observation direction relative to the direction of incidence. This method cannot be used for other angles because then shadow effects and multiple reflection of light from roughness elements which are not taken into account in the stochastically distributed surfaces method become important. This problem has been solved in the example of a very simple model which makes it possible to obtain important estimates. In this model it is possible to trace the fate of each ray incident on the surface separately; both the shadow effect and multiple reflection are taken into account. Refracted beams are neglected in order to study the characteristics of the phenomenon related only to reflection from the surface. Computations are made for two values of the refractive index:  $m_1 = \infty$  and  $m_2 = 1.340 - i0.005$ , cases corresponding to absolutely reflecting and opaque bodies. In marine optics  $m_1$  corresponds to microwave radiation and  $m_2$  to infrared radiation. In the model the surface is assumed to be periodic with a dispersion of slopes coinciding with the dispersion of the real sea surface. Caustic effects arise during single and double reflection. A formula is derived for computing the brightness coefficient of doubly reflected light. Computations are made for a sinusoidal surface. The values of the angles determining the directions of the caustics, and the  $\eta$  parameter, the ratio of the albedo of double reflection to the albedo of single reflection, are computed for different angles of incidence. The maximum  $\eta$  value for a model with a real dispersion of slopes is 20 and 13% for IR and microwave radiations respectively. The  $\eta$  maximum is at an angle  $\theta_0 \approx 75^\circ$  and with an increase in  $\theta_0$  the  $\eta$  value decreases greatly. Figures 6; tables 3; references: 5 Russian.

[317-5303]

## METHOD FOR COMPUTING EVOLUTION OF RANDOM HYDRODYNAMIC FIELDS ON BASIS OF ADJOINT EQUATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 21, No 2, Feb 85 (manuscript received 27 Apr 83,  
after revision 23 Apr 83) pp 115-122

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USSR Academy of Sciences; Marine Hydrophysics Institute, Ukrainian Academy  
of Sciences

[Abstract] The authors discuss methods for applying a stochastic-dynamic model when evaluating the state of random hydrodynamic fields. A method is given for computing the first two moment equations for random fields which is based on the neglecting of higher moments. Use of adjoint equations made it possible to develop an explicit method for computing the mean values and covariation functions of random fields close in their properties (with a small Courant number) to the implicit Crank-Nicholson method. Application of the method is illustrated in the examples of the one-dimensional linear heat transfer problem and the one-dimensional nonlinear velocity field evolution problem. The recurrent formulas derived for computing the first two moments are based on use of the properties of solutions of definitely formulated adjoint problems. Tabulation of these results was found to be the most economical method for applying the method. The accuracy of the method is tested by a comparison of the computed results and analytical solutions (for the linear problem) and also solutions of the problem computed by the Monte Carlo method (for the nonlinear problem). Figures 3; references 12: 8 Russian, 4 Western.  
[317-5303]

## ALLOWANCE FOR DIFFERENCES IN ELLIPSOIDS AND GEODETIC CONTROL COORDINATE SYSTEMS IN DETERMINING SHIP'S POSITION USING RADIO NAVIGATION SYSTEMS

Moscow EKSPRESS-INFORMATSIYA, SERIYA: MORSKAYA GEOLOGIYA I GEOFIZIKA  
in Russian No 3, 1985 pp 1-9

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[Abstract] In order to make full use of the accuracy of satellite radio navigation systems (RNS) and differential variants of the Loran-C and Omega RNS it is necessary to know the corrections  $\Delta B$ ,  $\Delta L$ ,  $\Delta H$  to the geodetic coordinates  $B_1$ ,  $L_1$  and the height  $H_1$  of the first ellipsoid relative to the second. Precise formulas are proposed for determining  $\Delta B$ ,  $\Delta L$ ,  $\Delta H$  in the form

$$\begin{pmatrix} \Delta B \\ \Delta L \\ \Delta H \end{pmatrix} = \begin{pmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{pmatrix} \begin{pmatrix} m \\ p \\ q \end{pmatrix} + \begin{pmatrix} d_1 \\ d_2 \\ d_3 \end{pmatrix}$$

where  $m, p, q$  are the coordinates of the second ellipsoid E2 relative to the center of the first ellipsoid E1. It is infeasible to compute  $\Delta B, \Delta L, \Delta H$  with an accuracy greater than 1 m because the error in determining  $m, p, q$  is 5-10 m. For practical computations it is possible to use formulas derived from the precise formulas above with dropping of terms with the square of eccentricity  $e^2$ . The relative error in computing  $\Delta B, \Delta L, \Delta H$  by these simplified formulas is  $3 \cdot 10^{-3}$  and therefore they can be used in many practical cases of determination of a ship's position. Other simplified formulas with which the error in computing the corrections is 1-2 m can also be used in computations involving use of tables of trigonometric functions and microcalculators. In determining a ship's position using a satellite RNS the coordinates must be transformed from a satellite geodetic system to a local system. This problem is discussed. A table shows how the  $m, p, q$  values can be used in computing the coordinates of centers of some ellipsoids relative to the centers of others. Formulas are given for evaluating the corrections required when transforming coordinates from the WGS-72 system to the Krasovskiy ellipsoid. Examples are given which show that discrepancies in coordinates in certain cases can be quite large. Tables 2.  
[333-5303]

UDC 525.623

#### DYNAMIC THEORY OF POLAR TIDE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 3, Mar 85  
(manuscript received 18 Apr 84) pp 3-16

MOLODENSKIY, S. M., Earth Physics, Institute, USSR Academy of Sciences, Moscow

[Abstract] The theory of the polar tide has been made more precise by means of allowance for the effect of inertial forces and bottom friction on tidal currents. Since it is most important to estimate the orders of magnitude, the examination is limited to a very simple model of the ocean on an absolutely solid earth and no allowance is made for self-gravitation effects--mutual attraction of different tidal wave elements. After derivation of the initial equations, the author analyzes the case of an arbitrary distribution of depth and an arbitrary shoreline. A model of an ocean of constant depth bounded by a real shoreline is considered, followed by a study of the influence of bottom friction. A system of ordinary differential equations is derived which describes the polar tide in the real ocean and a qualitative analysis of this system is given. It was found that in the absence of bottom friction



the deviation of the polar tide from a static position  $\xi$  is essentially dependent on the nature of the distribution of ocean depths and shoreline configuration: with an axially symmetric distribution of depths  $\xi$  is close to zero; for the real ocean  $\xi \neq 0$  even in the limiting case of a tidal frequency tending to zero. On the other hand, in the case of an ocean of constant depth and a real land-sea distribution the deviation of the polar tide from a static position results in a reduction of the Chandler period by approximately 8 days. In the open ocean bottom friction exerts no great influence on height of the polar tide. References 12: 7 Russian, 5 Western. [313-5303]

UDC 535.371

#### SEA WATER PHOTOLUMINESCENCE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 3, Mar 85  
(manuscript received 13 Dec 83) pp 481-483

GLEBOVSKIY, D. N., KIRILLOV, A. L., SIDORENKO, V. M. and CHETKAREVA, L. E.

[Abstract] The structure of the photoluminescence band of sea water was analyzed. Measurements of the luminescence of prefiltered water samples taken in the eastern part of the Black Sea were made. The measurements were made with a spectrometer whose recording system included a monochromator and photomultiplier operating in a photon-counting regime. Assuming, in accordance with the Kalle hypothesis, that the main source of sea water luminescence is the polymer product of condensation of the metabolites of marine organisms, its electron emission spectrum may consist of a series of bands corresponding to the electron transitions of polymer fragments. In order to demonstrate the individual nature of the compounds responsible for the bands observed in the spectrum the authors extracted samples of salts obtained by adiabatic evaporation of sea water at a temperature of 20°C. The luminescence spectrum of the sample with respect to frequency characteristics did not change with a concentration of the solution up to a solid state. This serves as indirect proof of the chemical stability of the organic compounds dissolved in sea water. Extraction was with a number of nonpolar and slightly polar solvents at a temperature of 20°, precluding the possibility of any change in the structure of the extracted substances. Depending on their nature, the solvents extract different groups of organic compounds, the total luminescence spectrum of which is registered in the initial sample. It is concluded that individual groups of organic compounds are responsible for the spectrum of sea water photoluminescence. Spectroscopic studies of individual groups of compounds must be made for a more detailed analysis of their nature. Figures 2; references 14: 8 Russian, 6 Western. [330-5303]



## MINERALOGICAL-GEOCHEMICAL CHARACTERISTICS OF FERROMANGANESE FORMATIONS IN ARABIAN-INDIAN OCEAN RIDGE

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 3, Mar 85  
(manuscript received 27 Jul 84) pp 28-32

SHNYUKOV, Ye. F., academician, Ukrainian Academy of Sciences, YANCHUK, E. A. and ORLOVSKIY, G. N., Geological Sciences Institute, Ukrainian Academy of Sciences, Kiev

[Abstract] Ferromanganese encrustations, films and nodules occur widely in the Arabian-Indian Ocean Ridge and in its fracture zones. The thickness of the films does not exceed fractions of a millimeter, they have a black color, usually are dull and are easily scraped off; the encrustations are from 0.5 mm to several centimeters thick. Figure 1 is a map of ferromanganese formations in the studied region; Table 1 gives the distribution parameters for the various elements in encrustations and nodules. The differences in the geochemical characteristics of the encrustations and nodules are analyzed. The paragenetic associations of elements which were detected in the encrustations and nodules were interpreted by a detailed mineralogical analysis. Particular attention is given to the presence of todorokite in the Fe-Mn nodules. It is demonstrated that the similarity of mineralogical-geochemical characteristics of nodules and encrustations is indicative that they have a common source of the main and ore-forming components and that the same genetic process is involved. Figures 2; tables 1; references 15: 9 Russian, 6 Western.  
[308-5303]

TEMPORAL VARIATIONS OF  $Rn^{222}$  CONCENTRATIONS IN BLACK SEA COASTAL ZONE

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 3, Mar 85  
(manuscript received 10 May 84) pp 3-5

ARBUZOVA, A. P., BATRAKOV, G. F., YEREMEYEV, V. N. and ZEMLYANOV, A. D., Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol

[Abstract] The article gives the results of prolonged measurements of the  $Rn^{222}$  concentration carried out on an oceanographic platform in the Black Sea near Katsiveli. Measurements of the  $Rn^{222}$  concentration and water temperature were made at depths of 0, 5, 10, 15, 20, 25 m twice a day for two months. Vertical profiles and observation series were obtained for the various horizons. Formation of the  $Rn^{222}$  concentration field is influenced by such factors as the content of  $Ra^{226}$  in sea water and its emanations in

the near-water atmosphere, wind direction and velocity, surface and internal waves, turbulent structure of currents and density convection. The field of  $Rn^{222}$  concentration can be considered random; it can be studied by the methods of mathematical statistics. The maximum variability of the studied characteristics is at the 15-m horizon. Maximum gradients of  $Rn^{222}$  concentration are observed in the upper thermocline. In this zone the  $Rn^{222}$  field is most sensitive to the influence of hydrodynamic processes of different spatial-temporal scales, such as internal waves, variations of the inertial period and turbulence. Advective processes exert a more significant influence on formation of the vertical  $Rn^{222}$  profiles in the coastal zone in comparison with the open sea. Also examined is the rate of gas exchange and the density of the  $O_2$  flux through the atmosphere-water interface. Figures 3; tables 1; references 4: 2 Russian, 2 Western. [308-5303]

UDC 621.371.22.4

# SEA SURFACE RADIO EMISSION AT WAVELENGTHS 0.86 AND 1.3 cm NEAR BREWSTER ANGLE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 2, Feb-Mar 1985 (manuscript received 4 Jan 84) pp 139-144

KROTIKOV, V. D., NIKONOV, V. N., PELYUSHENKO, S. A., PLECHKOV, V. M. and SHCHUKO, O. B., Radio Physics Scientific Research Institute

[Abstract] Measurements of sea surface brightness temperature were made at wavelengths 0.86 and 1.3 cm with vertical polarization. The investigations were made under different meteorological conditions, with different parameters of waves and at different water temperatures ( $T_0$ ). This made it possible to ascertain the dependence of sea surface brightness temperature ( $T_{br}$ ) on wind velocity. It was found that changes in the effective emissivity of the sea surface  $T_{br}/T_0$  at the Brewster angles attain 6-7%. The measurements were made in the Atlantic Ocean and the Black Sea. At 0.86 cm the measurements were made using a RT-0.6 radio telescope having a radiometer with a response of 0.07 K with a time constant of 1 sec and dish diameter 0.6 m. At 1.3 cm use was made of a radio telescope with a dish diameter of 1.5 m supplied with a radiometer having a response of ~1 K; the widths of the antenna directional diagrams were 56' at 0.86 cm and 50' at 1.3 cm. It is shown that a model of macroscale waves (with shading taken into account) both qualitatively and quantitatively describes the dependence of radio emission parameters of the water surface on its degree of wave development. When there are waves the sea surface at these wavelengths is always colder than the atmosphere at the horizon. There is an atmospheric brightness temperature maximum near the horizon whose degree and position are dependent on the averaging effect of the receiving antenna directional diagram and on the state of the sea surface and this maximum approaches the horizon with a decrease in the degree of wave development. With vertical polarization the contribution of the reflected atmospheric radio emission to the brightness temperature

of the sea surface observed near the Brewster angle is minimum and the magnitude of this contribution is virtually not dependent on total vertical absorption and degree of wave development. This makes it possible to carry out remote measurements of waves on the sea surface using observations of variations of brightness temperature of the sea surface near the Brewster angle. Figures 5; references 5: 3 Russian, 2 Western.  
[306-5303]

UDC 534.26

# ACCURACY IN DETERMINING VELOCITY OF FLUID MOVEMENT BY DOPPLER METHOD

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 28, No 2, Feb-Mar 1985 (manuscript received 12 Sep 83,  
after revision 22 Jun 84) pp 202-208

GURBATOV, S. N., MALAKHOV, A. N. and SHCHEMELEV, Ye. G., Gorkiy State University

[Abstract] The accuracy in determining the velocity of a fluid from the Doppler frequency shift of a signal scattered on discrete inhomogeneities transported by the fluid is examined. Such a problem arises in Doppler soundings of internal waves when the acoustic signal is scattered on such discrete inclusions as fish and plankton carried by the internal waves. The limit of accuracy in determining IW velocity is related to the finite width of the receiving-emitting system directional diagram, the finite duration of the sounding pulse and analysis time, as well as the presence of stray and instrument noise. The sounding is from a moving ship at the speed  $V_0$ . The objective is a theoretical validation of optimum choice of sounding angles when the directions of motion of the fluid and sounding source are known. Two cases are considered: when  $V_{\text{fluid}}$  velocity is directed parallel to  $V_0$ ; when  $V_{\text{fluid}}$  velocity is directed perpendicular to  $V_0$ . Separate expressions are derived for these cases. The signal-to-noise ratio  $q$  at the frequency detector output (effective Doppler frequency shift) is determined. It is shown that when  $V_0 \perp V_{\text{fluid}}$  the  $q$  maximum is obtained with  $\psi = 0$  (the value of the  $V_{\text{fluid}}$  projection onto the antenna axis is maximum and the distance to the scattering region with stipulated  $H$  is minimum). A different situation prevails when  $V_{\text{fluid}} \parallel V_0$ . Several regimes are possible, but in any case the  $q$  maximum is attained with  $\psi < 90^\circ$ . However attenuation must be taken into account; this leads to a decrease in the optimum sounding angle, whose values become  $\psi < 45^\circ$ . Figures 1; references 11: 9 Russian, 2 Western.  
[306-5303]

## SIXTH ALL-UNION MARINE GEOLOGY SCHOOL

Moscow EKSPRESS-INFORMATSIYA. SERIYA: MORSKAYA GEOLOGIYA I GEOFIZIKA  
in Russian No 2, 1985 pp 3-10

CHISTYAKOV, A. A. and KRASOVSKAYA, R. Ye., All-Union Foreign Geology  
Scientific Research Institute; All-Union Mineral Raw Materials Economics  
and Geological Prospecting Work Scientific Research Institute

[Abstract] The Sixth All-Union Marine Geology School was held at Gelendzhik during the period 16-22 April 1984 under the chairmanship of A. P. Lisitsyn, corresponding member, USSR Academy of Sciences. At the 13 symposia a total of more than 350 reports were presented, of which 28 were delivered at the plenary sessions. In his introductory report A. P. Lisitsyn presented new data on the geology of the seas and oceans during collected the two years which have elapsed since the last All-Union Marine Geology School. The following symposia were held: Paleooceanology and the Role of Oceanic Sediments in the Earth's History; Oceans of the Precambrian and Phanerozoic; Global Measurements of Ocean Level, Slide Sedimentation and Interruptions; Hydrothermal Activity, Sulfides on Ocean Floor; Biodifferentiation of Matter in the Ocean; Minerals in the Ocean; Mineralogy of the Oceans and Seas; Seismostratigraphy; Tectonics and Sedimentation; Intraplate Magmatism and Tectonics; History of Tethys Paleoocean; Geochemical Barrier and Limiting Zones and Their Role in the Formation of Sediments and Ores; Geomorphology of the Ocean Floor. The reports demonstrated that during the last two years there has been a considerable increase in interest in problems of geology and geophysics of the oceans and seas. Much new, original factual material was presented, important generalizations were made and plans for further research were outlined. [332-5303]

UDC 528.235:515.53

## USE OF STEREOGRAPHIC PROJECTION IN MARINE GEODESY

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA  
in Russian No 1, Jan-Feb 85 (manuscript received 1 Feb 84) pp 50-53

FOLOMKIN, G. M., assistant, Moscow Order of Lenin Institute of Geodetic,  
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[Abstract] The mathematical processing of the results of measurements made at sea is accomplished in a Gauss-Krüger projection. At the boundaries of 6° zones the linear distortions in a Gauss-Krüger projection for the middle zone of the USSR attain 1:2,000; this makes it necessary to introduce corrections into the lengths of the measured lines and the direction. For small regions with circular configurations it is advantageous to use a



stereographic projection. This gives lesser distortions and a more uniform distribution of these distortions over the territory of the work region. An important merit of the Roussilhe stereographic projection is that it is simple to achieve a tie-in between the Gauss-Krüger and Roussilhe coordinate systems. (This is discussed at some length.) In the Gauss-Krüger projection the distortion of lengths with increasing distance from the principal meridian increases; in the Roussilhe projection such distortions are only half as great. (A table given the quantitative characteristics of these distortions.) The practical use of a stereographic projection for the mathematical processing of measurements made at sea can be represented as follows: 1) a transformation from the coordinates of two points in a Gauss-Krüger projection to coordinates in a stereographic projection; 2) taking one of the computed points as the center of projection, compute the polar coordinates  $\delta$  and  $r$ ; 3) compute all the measurements made in this projection on the basis of the polar coordinates. Figures 1; tables 1; references: 3 Russian. [310-5303]

UDC 550.36:551.2

#### HEAT FLOW THROUGH OCEAN FLOOR AND ITS RELATIONSHIP TO LITHOSPHERE STRUCTURE AND THICKNESS

Moscow BYULLETEN' MOSKOVSKOGO OBNCHESTVA ISPYTATELEY PRIRODY: OTDEL GEOLOGICHESKIY in Russian Vol 60, No 2, Mar-Apr 85  
(manuscript received 18 Oct 83) pp 37-47

GORODNITSKIY, A. M., Oceanology Institute, USSR Academy of Sciences, Moscow

[Abstract] A review of the Soviet and foreign literature (31 sources are cited) reveals a general correspondence between experimental data and theoretical curves of decrease in heat flow with an increase in the age of the oceanic lithosphere. It is shown that there is a possibility of the use of background flow values for estimating its thickness. Since the mean weighted dispersion of measured values for a bottom age of more than 50 million years is about  $15 \text{ MW/m}^2$ , the error in such estimates can attain 25%. A comparison and joint analysis of computations of thickness of the lithosphere on the basis of data from geothermal investigations and identified magnetic anomalies and other geochronological determinations reveal their general good agreement. Use of data from heat flow measurements sometimes make it possible to obtain a more detailed picture of changes in the thickness of the lithosphere and also to detect regions of tectonic and volcanic activity and an anomalous structure of the crust. The fundamental possibility of using the results of geothermal research for estimating the thickness of the oceanic lithosphere is clear, but at the same time such determinations must be supplemented by estimates of thickness of the lithosphere on the basis of geochronological and gravimetric data, together with data from study of relief and data from magnetotelluric soundings. Figures 4; references 31: 20 Russian, 11 Western. [314-5303]



## DENSITY CHARACTERISTICS OF ASTHENOSPHERE IN ATLANTIC OCEAN

Moscow BYULLETEN' MOSKOVSKOGO OBSHCHESTVA ISPYTATELEY PRIRODY: OTDEL  
GEOLOGICHESKIY in Russian Vol 60, No 2, Mar-Apr 85  
(manuscript received 11 Apr 83) pp 32-36

LADYNIN, A. V., LITVINOV, E. M. and MASHCHENKOV, S. P., Sevmorgeologiya  
Geological Production Association, Leningrad

[Abstract] A clarification of the nature and mechanism of tectonic movements is closely related to study of stability of density characteristics of masses of asthenospheric matter, the detection of possible density inhomogeneities and their areal distribution. This problem cannot be solved directly on the basis of data on anomalies of the gravity field. However, a promising approach to solution of this problem is the use of the dependence of density on temperature, but a knowledge of temperature distribution in the asthenosphere is required. Such information can be obtained from general concepts on those PT conditions under which there is a decrease in the viscosity of matter to the level characteristic for the asthenosphere, also making use of data on measurements of the heat flow through the ocean floor. Since density inhomogeneities are known to exist in the asthenosphere, a study was made of the lateral distribution of temperature and temperature coefficients of density were found which could be used with certain assumptions concerning the composition of matter in the asthenosphere and the adjacent rocks of the upper mantle. Formulas were derived for determining the required parameters. These were used in mapping the heat flow in squares measuring  $2^\circ \times 2^\circ$  for the entire area of the Atlantic. This map shows lateral density changes in the upper atmosphere. The morphology of density changes regularly reveals a submeridional structure of the axial part of the Atlantic asthenosphere with reduced density. A reduced density is characteristic of the boundaries of the mid-oceanic ridge. Within this gigantic zone there are extensive regions with a sharp reduction in the density of matter, in both the North and South Atlantic. The deep processes determining the existence of the divergent boundaries of lithospheric plates in the Atlantic Ocean not only significantly reduce density of the crust and lithospheric layer of the upper mantle within the limits of the zone of riftogenesis, but also are similarly reflected in lateral density changes in the underlying asthenosphere. Figures 1; references 10: 8 Russian, 2 Western.  
[314-5303]

## INFLUENCE OF UNDERWATER VOLCANIC MOUNTAINS OF ATLANTIC ON MICROPLANKTON DISTRIBUTION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA  
in Russian No 1, Jan 85 pp 20-25

LOPUKHIN, A. S., Biology of the Southern Seas Institute, Ukrainian  
Academy of Sciences

[Abstract] The concentration of adenosine triphosphate (ATP) in microplankton communities was determined in waters over underwater volcanic mountains in the Atlantic Ocean consisting of basaltic and ultrabasic rocks on the 11th and 13th cruises of the scientific research ship "Professor Vodyanitskiy" (1981-1982). The microplankton distribution was studied over 12 peaks (listed in a table) situated at different latitudes (from 53°N to 27°S) and at different depths (from 60 to 940 m) in five regions of the Atlantic. It was found that over such volcanic mountains in the photic region there are domelike water masses with a microplankton content which is less than in the surrounding waters. Lenticular masses with a relatively increased microplankton content are formed over the slopes of mountain peaks in the euphotic zone away from the dome of impoverished waters. The positioning of such lenses is controlled by the transport of biogens into the zone of active photosynthesis and by hydrodynamic conditions. The reason for this stratification of waters is unclear. Quasistationary eddies of the type of Taylor-Proudman columns are probably formed over the peaks; these isolate the water mass over the peak from the surrounding waters (blocking effect). An increase in the duration of presence of microorganisms in the zone of anomalously increased strength of the geomagnetic field disrupts optimum metabolic processes in the cells and results in a reduction in their number over the peaks. The mean ATP concentrations in microplankton in the waters surrounding underwater mountains exceed the background values in the open ocean by a factor of 2-3, evidence of a relatively increased biological productivity in such regions. Figures 2; tables 1; references 9: 6 Russian, 3 Western.  
[311-5303]

## TERRESTRIAL GEOPHYSICS

### PROJECTS OF THE COMPUTER CENTER OF THE ACADEMY'S SIBERIAN BRANCH

Moscow PRAVDA in Russian 8 Apr 85 p 7

[Article by Ye. Solomenko]

[Abstract] The lengthy article reports on activities of the Computer Center of the Siberian Branch of the USSR Academy of Sciences. The center's director is academician A. Alekseyev. The center is located in a five-story building in Novosibirsk.

Examples of the center's work in support of various industries and services are reported. Alekseyev directed a cycle of work on physical-technical principles of vibration sounding of the Earth's interior, for gathering geological information. The laboratory of automated systems for gathering information, which is headed by B. Glinskiy, built field computer complexes for geological parties to use in this method of geological surveying. S. Vas'kov, head of the department of applied geophysics, related that his group is now working on a satellite hook-up for transmitting the geological information from the field to the computer center. It is noted that the center is the base of a recently opened center for processing of geoinformation, which analyzes aerospace photographs not only for geological purposes, but also in support of agriculture and forestry.

In addition to applications of computers, the center reportedly is also doing research on computer technology and computer systems of the future. It has designed a number of computer networks, one of which provides collective use of all the computers of facilities of the Siberian Branch located in Novosibirsk. This network is to be extended to all institutes of the branch throughout Siberia. One of the center's most important long-term projects is the "MARS", which is an acronym for 'modular asynchronous expandable system.' It aims at flexible computer complexes which will be adaptable to specific conditions of a given research institute or design bureau. V. Kotov, the center's deputy director, explained that such complexes require the development of super-computers that will mark the advent of the fifth computer generation. Collaborating with the center on this project are the Computer Center of the USSR Academy of Sciences in Moscow, the Estonian Academy of Sciences' Cybernetics Institute, and industry design bureaus and enterprises. It is said that "MARS" machines will be capable of recognizing visual images and accumulating information independently, and of working with imprecise data. They will be capable of working out their own programs for the solution of problems posed for them.

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CSO: 1865/345

## DISCOVERY IN EARTHQUAKE FORECASTING AND SEISMIC ZONING RECORDED

Baku BAKINSKIY RABOCHIY in Russian 26 Apr 85 p 2

[Article by R. Akhmetov]

[Excerpt] A scientific discovery in the field of earthquake forecasting and seismic zoning was recorded in the USSR State Registry of Discoveries on April 25. Its author, corresponding member of the USSR Academy of Sciences I. Ye. Gubin, approached the solution of this problem from a fundamentally new position.

Seismic zoning maps have been compiled for a long time. But they have not fully reflected the geological processes which determine the origins of subterranean tremors. In the course of many years of seismotectonic studies, it has been established that the size of an earthquake center, that is, the area of the fracture surface, and its magnitude (energy) are determined by the dimensions of the blocks of the Earth's crust which shift along faults. This is the essence of the scientific discovery. It has opened the way for compiling seismic zoning maps of a basically new type. They indicate zones of centers of origin of future earthquakes, and list their characteristics in detail: the force of possible subterranean tremors, the frequency of their repetition, the size and depth of centers which affect the force of tremors at the Earth's surface. In many regions of Central Asia and India for which such maps have been compiled, 23 strong earthquakes have occurred during the past 40 years. All of them occurred in places indicated on the maps. Their characteristics also were confirmed.

The Moscow scientists' discovery has laid the groundwork for a new scientific direction in seismology, and has led to a qualitative, radical restructuring of seismic zoning methods.

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## AEROSPACE TECHNOLOGY DETERMINES FOREST-FIRE DANGER

Kishinev SOVETSKAYA MOLDAVIYA in Russian 17 Apr 85 p 4

[Article by V. Vasil'yev]

[Text] Forest fires in the taiga not only can be detected but also forecast with the aid of meteorological satellites. This conclusion has been reached by Krasnoyarsk and Moscow scientists who have developed a new method of predicting natural disasters.

Information from "Meteor" satellites and airplanes on fire-patrol duty is decoded at a large computer center that is now in operation in Krasnoyarsk. Evaluations of data are made by associates of the Krasnoyarsk Forestry and Timber Institute of the USSR Academy of Sciences' Siberian Branch. Unfortunately, the natural disasters which this system was capable of detecting up until recently were chiefly ones that had already begun. But what about forecasts?

After posing this question, associates of the institute noticed that the radio-frequency heat radiation of sectors of soil with different moisture contents differed sharply from each other. At the same time, the water-content limit below which mosses, peat mosses and grasses become subject to combustion was well-known.

Precise and painstaking work began. The Siberian scientists met with success almost at the very beginning of this work. A microwave radiometer that had been developed at the USSR Academy of Sciences' Institute of Radio Engineering and Electronics and was being used in many branches of the economy proved to be also quite suitable for determining the moisture content of soil. This instrument is being installed only on airplanes at present. Meteorological satellites will also begin to be equipped with the instrument in the future, after it has been perfected.

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## TECTONIC STRUCTURE FEATURES OF SOME DEEP FAULTS IN ATLANTIC AND PACIFIC OCEANS (ACCORDING TO DEEP SEISMIC SOUNDING-REFLECTED WAVES METHOD DATA)

Moscow GEOTEKTONIKA in Russian No 2, Mar-Apr 85  
(manuscript received 22 Mar 83) pp 104-119

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imeni P. P. Shirshov, Moscow; Southern Section, Oceanology Institute  
imeni P. P. Shirshov, USSR Academy of Sciences, Gelendzhik

[Abstract] The characteristics of tectonic structure of the earth's crust have been generalized on the basis of studies of faults in the Atlantic and Pacific Oceans carried out during the period 1973-1979 by the deep seismic sounding and reflected waves methods. There are three types of faults which differ in their structure. In faults of the Atlantic type it is the separation components which predominate. These are responsible for the dominance of fault structures and the presence of deep intrusions in the structure of the earth's crust. The Pacific Ocean type of faults includes structures caused by compressional components and as a result, possibly, the formation of shaly metamorphized rocks in melange zones (Heezen, Murray, Clipperton faults). The Emperor fault belongs to a third type in which the dilatational components lead to the formation of structures of the graben type but deep discontinuities do not rise along the fault axis. There are abrupt depth differences in bottom relief: high ridges and deep canyons. There is a complex structure of the second layer, represented almost everywhere by two strata. The upper, with a thickness of 0.5-1.5 km, is in the form of lenticular bodies with an extent from 5 to 15 km, whereas the lower is in the form of blocks with an extent from 2 to 5 km and a thickness of 1-3 km. There is a decrease in thickness of the second layer in the axial zones of faults of the Atlantic type. There is a relative uniformity of the third layer, with a thickness from 5 to 9 km, which can be arbitrarily divided into lower and upper strata. There is a fragmentation of the third layer into blocks with an extent up to 6-7 km with a decrease in their size to 0.5 km toward the fault axis. In the axial zone of faults the crust is fragmented into small blocks (1-3 km); intrusions of deep rocks (in dilatation zones) and melange rocks (in compression zones) are present here. Figures 6; references: 30 Russian.  
[309-5303]

## SPACE METHODS FOR GEOLOGICAL RESEARCH

Moscow SOVETSKAYA GEOLOGIYA in Russian No 3, Mar 85 pp 6-14

BUSH, V. A., BRYUKHANOV, V. N., All-Union Foreign Geology Scientific Research Institute, and MEZHELOVSKIY, N. V., USSR Ministry of Geology

[Abstract] At the 26th International Geological Congress the advances in aerial and space methods for geological research were discussed for the most part in the section "Remote Sensing." In addition, 15 reports on this subject were presented at the sections "Engineering Geology" and "Mathematical Geology and Geological Information" (individual reports were presented in the sections "Quaternary Geology and Geomorphology" and "Comparative Planetology" and at the seminar on "Tectonics of Asia"). The most important of the review reports, reports on methods for using remote data for geological mapping, new geological data obtained by use of aerospace methods, methods for processing space information and new methods and immediate prospects for the development of remote sensing are covered in this overview of the reports presented. The following are the principal directions in the development of remote geological sensing methods. A systemic approach to use of materials from remote surveys in different stages of the geological prospecting process, a direction being pursued primarily by Soviet scientists. Production of new types of geological maps, primarily on the basis of surveys from space, such as space tectonic and space photogeological maps. Study of the nature of geological formations on the basis of their spectral characteristics, affording broad possibilities for lithological mapping by remote methods. Specialized processing of remote, geological, geophysical and geochemical data, making use of computers and displays. Study of the nature, geological structure and mineragenetic importance of annular structures. Use of remote survey data in the search for and prediction of mineral deposits. Interpretation of space photographs for solving major problems in regional and global geology and tectonics. Development of international scientific cooperation in application of geological remote sensing methods. None of these methods will replace traditional methods, but will greatly advance research in the fields of geological mapping, tectonic, geodynamic and mineragenetic studies.

[315-5303]

## PHYSICS OF ATMOSPHERE

### SYMPOSIUM ON LUMINESCENT RADIATION RECEIVERS AND CONVERTERS

Tallin SOVETSKAYA ESTONIYA in Russian 25 Apr 85 p 2

[Article by G. Khyutt, Candidate of Physical-Mathematical Sciences, senior science associate of the Estonian Academy of Sciences' Institute of Geology]

[Excerpt] The Fifth All-Union Symposium on Luminescent Receivers and Converters of Ionizing Radiation ended recently in Tallin. The symposium was organized by the USSR Academy of Sciences' Department of General Physics and Astronomy, the Estonian Academy of Sciences' Institute of Geology, and Tartu State University.

Beginning in 1973, these all-Union symposia have been held every three years under the auspices of the USSR Academy of Sciences and its Scientific Council on Luminescence. Specialists in luminescence and luminophors have taken part in the symposia, as have developers and researchers of corresponding instruments.

Taking part in the latest symposium were 230 specialists from Moscow, Tallin, Tartu, Riga, Leningrad, Irkutsk, Stavropol', L'vov, Khar'kov, Sverdlovsk, Tomsk and other cities. On the program was a record number of reports (160!) -- four times as many as were given at the first symposium in Moscow. Moreover, topical discussions were held on the problems "Regularities Governing Roentgenoluminescence, Radioluminescence and Thermoluminescence and Their Connection with the Structure of Luminophors", "Luminescent Equipment for Dosimetry", and "Luminescent Converts of X-Ray Images".

The method of thermoluminescent dosimetry was a topic of the meeting.

Also discussed were scientific research and developments in the field of x-ray screens that are used in medicine. Presented for the first time were a number of works devoted to luminescent detectors for computer tomography.

And, lastly, results of basic research of mechanisms of interaction between radiation and matter, and of the nature of luminescent materials were a subject of discussions that attracted much interest.

For more than 30 years, scientists of Estonia have been contributing their share to the advancement and application of luminescence. Research of both basic and applied problems of luminescence is in progress on a broad scale at Tartu University, the USSR Academy of Sciences' Institute of Physics, the Estonian academy's Institute of Geology, and the Tallin Polytechnical Institute.

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## MATHEMATICAL MODEL OF GLOBAL PROCESSES IN THE BIOSPHERE

Moscow NTR: PROBLEM I RESHINYA in Russian 2-16 Apr 85 p 7

[Article by V. Krapivin, Yu. Svirizhev]

[Excerpt] What will happen with the biosphere if:

the content of carbon dioxide in the atmosphere grows;

the area of cultivated land and the productivity of livestock raising are increased by 10 percent by the year 2000;

capital investments in the replenishing of natural resources are double, and in the fight against pollution are 10 times what they are now?

Answers to these and other questions have become possible thanks to the development of a mathematical model of global processes in the biosphere, at the computer center and other organizations of the USSR Academy of Sciences.

The model -- a 'mathematical portrait of the biosphere' -- reflects the system of interconnected ecological, climatic, biogeocenotic and socioeconomic processes that are at play in the biosphere. It is based on a fundamental concept of academician V.I. Vernadskiy, who viewed the biosphere as a 'part of the Earth's crust occupied by transforming agents that turn cosmic radiations into active terrestrial energy -- electric, chemical, mechanical, thermal, etc.' Proceeding from this concept, biosphere dynamics can be represented in the form of a diagram of flows of energy and matter.

In the model, the biosphere is divided into the atmosphere, land and ocean. The atmosphere is characterized by temperature, and by content of carbon dioxide and water vapors, nitrogen and sulfur compounds, and dust. The surface of the land and the ocean is divided into sectors of 4 degrees in latitude and 5 degrees in longitude, within which all processes are considered homogeneous. Moreover, the vertical heterogeneity of ocean systems is considered. Account is taken here for hydrodynamic and biological processes which influence the formation of global biogeodynamic cycles of carbon, nitrogen, phosphorus and sulfur. On land, the main biospheric components are considered to be 30 types of vegetation; reserves of humus, water and minerals (oil, coal, metals); and population density.

In describing human activity, account is taken for demographically known relationships of the birth rate and death rate to environmental parameters and socioeconomic parameters (food supply, material level).

The biosphere model has been realized in the form of a set of programs; it can be used for dialog between an investigator and a computer, which permits rapid analysis of processes which vary in structure and character.

To use the model, researchers prepare a set of various scenarios which simulate variants of the future development of society, management policies, and estimates of tempos of technological progress. Then the model is asked to reckon, "What will happen with the biosphere if...?"

Model forecasts of the condition of the biosphere indicate that at the [present] growth of population density and growth in human economic activity, the amount of carbon dioxide in the atmosphere will grow. It will grow an average of 6.2 percent every 10 years, with a noticeable tendency for the growth to diminish. In the year 2000, the content of carbon dioxide in the atmosphere will be 18.7 percent greater in comparison with 1970.

The model makes it possible to evaluate the consequences of large-scale influences of humans on the biosphere, including nuclear war, and the magnitude of the 'price of mistakes' from humans' interference in nature, which is not always carefully planned.

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## MORE ON SHOCK-WAVE STUDIES WITH "PROGNOZ-10" SATELLITE

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 27 Apr 85 p 4

[Article by G. Lomanov]

[Excerpt] The tenth satellite of the "Prognoz" series has gone into orbit around the Earth. This satellite is intended for the study of interplanetary and near-Earth shock waves, and its research program and apparatus were prepared by about 20 research and design institutions of the Soviet Union and Czechoslovakia.

"Interesting phenomena occur on the distant approaches to our planet," related Doctor of Physical-Mathematical Sciences A. Galejev, head of a department of the USSR Academy of Sciences' Institute of Space Research. "The earth is fanned constantly by streams of solar wind. This is hot and very rarefied plasma. The solar wind forms a shock wave when it encounters the obstacle of our planet's magnetosphere. The existence of shock waves also in interplanetary plasma has been demonstrated theoretically by academician R. Sagdeyev, and now the time has come to study the mechanism of the formation and spread of these waves in greater detail."

It should be noted that processes occurring on boundaries as the solar wind flows around the Earth's magnetic field have been under study for about a decade. Shock waves were recorded by the satellite "Prognoz-8", in particular. Why do scientists have special hopes riding on the "Intershok" experiment?

"The solar wind blows constantly; the shock wave it generates on the boundary of the magnetosphere also is always in existence, and the satellite encounters this wave twice on each of its orbits," explained A. Galejev. "The thing to do is to record parameters and accumulate and analyze such information, it would seem. But it is not all as simple as that. The wave itself is comparatively thin; moreover, it fluctuates constantly due to gusting of the solar wind, first approaching the Earth and then receding from it at a speed as high as 100 kilometers a second. And the satellite passes through the wave literally in one second. Interplanetary shock waves generated by powerful solar flares also exist in near-Earth space. We are interested in them, too, but their speed is about 10 times as great; a satellite passes through such a wave in tenths of a second."

FTD/SNAP

CSO: 1865/345

## FUNCTIONS OF 'PROGNOZ-10--INTERCOSMOS' STATION EXPLAINED

Moscow IZVESTIYA in Russian 27 Apr 85 p 3

[Article by B. Kononov]

[Excerpt] Imagine a collector who is interested only in those moments of hockey and soccer matches when goals are scored. He would record a whole game on video tape, and as long as no goal was scored, the present action would be erased automatically one minute later. But when the ball or puck hit the nets, this exciting moment and all action that preceded it for one minute beforehand would immediately be transrecorded to another video recorder, and then the situation that led to the goal could be viewed as many times as one pleased.

This roughly describes the unique mode of operation of the new "Prognoz-10" satellite, which is beginning to function in line with the international program called "Intershok". The 'goals' that it will record are interplanetary and near-Earth shock waves. The satellite is flying in an elongated elliptical orbit, 200,000 kilometers distant at its apogee and returning to within 400 kilometers at its perigee. In the four days that it takes the satellite to make one orbit around Earth, three are spent traveling in purely interplanetary space, and one day is spent within the Earth's magnetosphere.

The Earth's magnetic field presents a serious obstacle in the path of the solar wind of charged particles flying from the sun at immense velocity. When they meet the obstacle of Earth's magnetosphere, a shock wave occurs. This wave stretches out for about 100 kilometers, a distance through which it takes the satellite one second to pass.

This is why a 'goal anticipation' mode of operation has been chosen. As soon as there is a 'hit' signal, the satellite's ring memory, where all current measurement data are recorded and then erased, 'freezes' the situation at the instruction of the onboard computer. Everything that took place for 50 seconds prior to this is recorded by the computer into the long-term memory. In addition, for the next five minutes all the satellite's instruments operate in the fast-measurement mode, the data entering the long-term memory, and from it to Earth.

In one orbit, the satellite must record at least two 'goal moments,' but it may record more: a near-Earth shock wave, which is usually found 100,000 to 150,000 kilometers from the planet, does not remain in the same place, and it is constantly 'breathing.' Therefore the satellite may encounter it more than once. And during the three days that the satellite is flying outside the limits of the magnetosphere, it may record rare interplanetary shock waves which originate from explosive processes on the sun.

The scientific instruments installed on "Prognoz-10" permit detailed studies of the composition and energy of particles, and measurement of the sun's short-wave and radio radiation. The whole arsenal of sophisticated instruments was developed in close collaboration between Soviet and Czechoslovak scientists. About 20 organizations took part. On the Soviet side, the chief one was the USSR Academy of Sciences' Institute of Space Research, and on the Czechoslovak side, it was the Astronomy Institute of the Czechoslovak Academy of Sciences.

FTD/SNAP

CSO: 1865/345

' PROGNOZ-10--INTERCOSMOS ' STATION LAUNCHED TO STUDY SHOCK WAVES

Moscow IZVESTIYA in Russian 27 Apr 85 p 3

[Text] The automatic station "Prognoz-10--Intercosmos" was launched from the Soviet Union on April 26, 1985, at 9:48 a.m., Moscow time.

The purpose of the launching of the station is to conduct studies of the structure of interplanetary and near-Earth shock waves that occur when the plasma of the solar wind interacts with the Earth's magnetosphere.

Installed on the station is scientific apparatus which was developed by scientists and specialists of the Soviet Union and the Czechoslovak Socialist Republic in line with the program of international cooperation in the field of research and use of space for peaceful purposes.

The automatic station was placed into a highly elliptical Earth-satellite orbit with the parameters: maximum distance from Earth's surface (at apogee) -- 200,000 kilometers; minimum distance from Earth's surface (at perigee) -- 400 kilometers; initial period of revolution -- 96 hours 25 minutes; orbit inclination -- 65 degrees.

The onboard systems and scientific apparatus of the "Prognoz-10--Intercosmos" station are functioning normally.

The coordination-computer center and institutes of the USSR Academy of Sciences are processing the information that is being received.

FTD/SNAP  
CSO: 1865/345



## INSTITUTE WORKS ON MODELING THERMONUCLEAR PLASMA PROCESSES

Vil'nyus KOMSOMOL'SKAYA PRAVDA in Russian 27 Apr 85 p 3

[Article by D. Vatsek]

[Abstract] The article is an interview with Doctor of Physical-Mathematical Sciences, Professor Zenonas Rudzikas, deputy director of the Lithuanian Academy of Sciences' Institute of Physics.

Rudzikas comments on results of nuclear-physics research by himself and other scientists of the institute. He mentions a monograph, "Principles of a Theory of Spectra of Atoms and Ions", which he co-authored with Professor A. Nikitin of Leningrad University. This monograph summarizes results of many years of work aimed at developing mathematical methods for the study of complex atoms and ions -- methods which can be used in astrophysics for ascertaining the structure and properties of the sun, for example. Rudzikas reports that scientists of the physics institute are seeking to apply methods described in the monograph to mathematical modeling of processes in high-temperature thermonuclear plasma. Data that they have obtained are being evaluated at the Institute of Atomic Energy imeni Kurchatov.

Rudzikas also comments on research with applications in molecular biology, metalworking and environmental protection which personnel of the institute have been pursuing, using lasers and conventional methods. Academician Yu. Vishchakas is directing laser-aided research of extremely high-speed processes in molecules, results of which can be used in the study of living cells. A group headed by Doctor of Technical Sciences R. Kanapenas is studying laser cutting of steel rods and sheets, laser hardening of products, and other industrial uses of lasers. Scientists under the direction of Professor B. Styro, corresponding member of the Lithuanian academy, have been studying the radioactivity of the atmosphere. Developments of this group are said to be of practical importance in connection with the building of the Ignalina Nuclear Power Station, where a laboratory has been set up to study the environment in the vicinity of the station.

Rudzikas mentions in conclusion that scientists of the institute have developed airborne and other equipment for analyzing the composition of the atmosphere and detecting sources of pollution. An automatic device for monitoring microclimate parameters, the "EOL-I", has been developed, as well as an instrument for measuring small concentrations of mercury in the natural environment and indoors. Work is nearing completion on a fluorescent analyzer for monitoring the nitric-oxide content of the air in plant shops, for example.

VARIABILITY OF AIR HUMIDITY PROFILES OVER OCEAN DETERMINED BY LIDAR SOUNDING

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 21, No 3, Mar 85 (manuscript received 5 May 83) pp 324-327

BORODIN, V. G., BUKIN, O. A., STOLYARCHUK, S. Yu. and TYAPKIN, V. A.,  
Pacific Ocean Oceanological Institute, Far Eastern Scientific Center,  
USSR Academy of Sciences

[Abstract] Lidar sounding of the humidity layer over the Mediterranean Sea and in the Indian Ocean was carried out during the first cruise of the "Akademik A. Nesmeyanov" in the summer of 1982. About 30 humidity profiles were obtained which were classified into three groups corresponding to the climatic zones of the ocean. In the experiment the optical axes of the source and receiver were spaced 20 cm apart and the extent of the lidar shadow zone in the direction of sounding was ~16 m. The lidar had the following parameters: laser radiation wavelength--532 nm; pulse power--13 MW; sounding pulse repetition rate--12.5, 25 Hz; reception angle--0.3°; sounding pulse divergence--0.1°. Sounding was along a slant path through the ship's side port; inclination to the horizon was 14°. Seventeen soundings were made in the Mediterranean Sea and 8 in the Indian Ocean. The method proved to be applicable both at drift and when the vessel was proceeding on course when sea waves were up to class 4. The soundings revealed a difference in structure of the humidity profiles in the lower 100 m (logarithmic decrease) and subsequent 100-360 m (uniform or inversion layer in Mediterranean Sea, in the equatorial zone a uniform layer of about 700 m). It was possible to ascertain humidity parameters at the horizons 10-250 m and trace the development of nighttime convection over the sea and the height at which it develops. Figures 3; references 16: 14 Russian, 2 Western.  
[318-5303]

## USE OF RADAR WITH FREQUENCY MODULATION FOR STUDYING ATMOSPHERIC BOUNDARY LAYER

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 21, No 3, Mar 85 (manuscript received 7 Dec 82, after revision 19 Jun 84)  
pp 277-284

ZHEZHERIN, V. R. and KNYAZEV, L. V., All-Union Machine Building Correspondence Institute

[Abstract] The development of semiconductors and digital processing methods has made it possible, for some purposes, to replace pulsed radars with continuous-radiation radars which are less expensive, simpler and more compact. The article gives the results of use of such apparatus in measurements of the vertical component of velocity of motion of scatterers using apparatus with continuous radiation and linear frequency modulation. The outfit used was developed on the basis of the RAZ decimeter-wavelength Doppler radar and has a microwave channel common with it which makes possible a virtually instantaneous changeover from a regime of radioacoustic measurements to a radar operation. The described radar with linear frequency modulation (FM-CW) has no high-voltage components or complex coaxial waveguide channel required for pulsed radars and therefore is smaller and easier to use. The disadvantages of the FM-CW apparatus include a need for separate receiving and transmitting antennas and it is impossible to evaluate the reflected signal without recourse to its Fourier analysis. The FM-CW radar cannot function with small angles of elevation. Structure of the apparatus employed is illustrated in a block diagram. The type of information which can be obtained with such a radar is illustrated in the example of the spectra of signals reflected from raindrops and nonuniformities of the refractive index in the atmospheric boundary layer. It is possible to obtain data from low heights (~20 m) with a relatively low power of the transmitter (10 W). It is possible to detect clear-sky reflections to altitudes 1,000 m, to determine their velocity and relative reflectivity. The FM-CW radar is easily matched with acoustic and radioacoustic sounding systems. Figures 4; tables 1; references 13: 6 Russian, 7 Western.  
[318-5303]

## ADDITIONAL POSSIBILITIES OF RADIOMETEOR AZIMUTHAL METHOD FOR MEASURING WIND VELOCITY IN LOWER THERMOSPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 21, No 3, Mar 85 (manuscript received 18 Feb 83, after revision 30 May 84) pp 254-261

GAYNUTDINOVA, R. D. and KARIMOV, K. A., Physics Institute, Kirgiz Academy of Sciences

[Abstract] The need for applying meteor measurements to solution of geophysical problems and the needs of meteorology not only require a more precise determination of vertical velocities, but also better evaluations of characteristics of wind flow deformation than is possible by the Greenhow and Manning methods, which are inadequate for this purpose or encumbered by serious errors. Accordingly, the authors have examined additional possibilities of the radiometeor azimuthal method for measuring wind velocity which follow from the condition of wind field nonuniformity within the limits of the sounding region. Expressions are derived for determining the characteristics of wind field nonuniformity at the considered altitudes. Experimental estimates of the characteristics of wind field nonuniformity in the meteor zone were obtained on the basis of the results of radiometeor wind measurements in 8 azimuths carried out in 1978-1979. This made it possible to compute the mean daily value of plane divergence  $D_0$ , deformation components  $A_0$  and  $B_0$  and vertical velocity  $w_0$ . It was found that the mean daily divergence and vertical velocity values in the meteor zone in the course of the year vary in the range  $\pm(1-8) \cdot 10^{-6} \text{ sec}^{-1}$  and  $\pm(1-5) \text{ cm/sec}$  respectively. In the winter half-year at meteor altitudes there are descending movements, whereas in the summer season there are ascending movements. The maximum  $w$  values attain 1.2 cm/sec. Allowance for wind field nonuniformity in the meteor zone affords new possibilities for the azimuthal radiometeor method for measuring wind velocity at these altitudes. Figures 1; references 19: 14 Russian, 5 Western.

[318-5303]

## GLOBAL MODEL OF TRANSPORT OF POLLUTANTS IN ATMOSPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 21, No 3, Mar 85 (manuscript received 25 Nov 83) pp 236-246

PENENKO, V. V. and PANARIN, A. V., Computer Center, Siberian Department, USSR Academy of Sciences

[Abstract] A three-dimensional global model of transport of pollutants in the atmosphere is described; it includes corresponding systems of

fundamental and adjoint equations. The scheme for applying the model is based on the splitting method with use of approximations of an increased order of accuracy, supplemented by special so-called "monotonization" operators. Examples of numerical experiments carried out on the basis of this model are presented. In these examples the elements of the hydro-meteorological regime are computed using FGGE level-III data. The splitting procedure used makes possible formal separation of dynamic transport processes from pollution transformation processes and the application of corresponding parts of the model can be accomplished in different stages, bringing them together at the level of information exchange within the framework of a general splitting scheme. The pollutants are assumed to be multicomponent. In the transport stage each substance enters separately from the others into the entire integration domain. In the transformation stage all substances are taken into account simultaneously, but locally at each grid point. The elements for applying the transport model are universal but the elements for application of the transformation model are specialized for specific cycles of reactions and groups of substances participating in the reactions. The article emphasizes the transport model as a standardized element of a more general model which includes a set of transformation models. Examples are given showing that even from localized pollution sources contaminants can be transported for considerable distances and atmospheric pollution must be examined on a global scale. Figures 2; references 11: 7 Russian, 4 Western.  
[318-5303]

UDC 550.388.2

#### SMALL-SCALE STRUCTURE OF IONOSPHERIC F-REGION

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 28, No 3, Mar 85 (manuscript received 25 Jan 84) pp 283-292

ZASENKO, V. Ye., Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Siberian Department, USSR Academy of Sciences

[Abstract] During ionospheric sounding the reflected signal is much of the time diffuse. This diffuse state has not yet been adequately studied because the low resolution of rectangular radio pulses with a duration of about 100  $\mu$ sec (usually used in studying the ionosphere) does not make it possible to ascertain the internal structure of the diffuse signal. This article describes the morphology of the fine structure of diffuse reflections and gives an interpretation of new experimental data on the small-scale part of the spectrum of ionospheric inhomogeneities responsible for the diffuse signal. The data were obtained during vertical sounding using an apparatus operating with a complex signal which made it possible to increase the accuracy in measuring altitude and vertical resolution to 1.5 km, an order of magnitude better than when using standard apparatus. The observations were made at Irkutsk by the method of continuous registry of virtual altitude during vertical sounding by the ( $h'(t)$ ) method at a fixed frequency in the



range 3-4 MHz, which corresponds to reflection from the lower part of the F-region. Specific, detailed examples of observations are discussed and illustrated. It is shown that the use of complex signals having a high resolution makes it possible to study the internal structure of diffuse signals. This made possible the experimental detection of the effect of periodic generation and splitting of small-scale inhomogeneities moving in the ionosphere. Information is given on the periodic structures present in the diffuse signal. Such information can serve as a basis for evaluating the reliability of theoretical computations of the appearance and existence of small-scale ionospheric inhomogeneities. Figures 6; references 8: 7 Russian, 1 Western.  
[344-5303]

UDC 621.375.826:551.510.3

SPECIFICS OF LASER SOUNDING OF ATMOSPHERE ALONG HORIZONTAL AND SLIGHTLY SLANTING PATHS OVER WATER SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 21, No 2, Feb 85 (manuscript received 14 Feb 83, after revision 16 Jun 83) pp 214-215

GRISHIN, A. I. and MATVIYENKO, G. G., Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences

[Abstract] In laser sounding of the atmosphere no adequate studies have been made of the influence of the underlying surface on signal strength and shape, particularly in soundings along horizontal or slightly sloping paths. This can cause distorted estimates in determining atmospheric parameters. The authors have estimated the contribution of rereflection by a water surface to a lidar signal when making soundings along such paths. The case of atmospheric sounding along a horizontal path by a lidar situated at a stipulated height above the water surface is examined. The example given reveals the influence of rereflection on retrieval of the spatial structure of the backscattering coefficient  $\beta$  for a monostatic lidar with stipulated characteristics. Undistorted profiles were obtained only for a height above sea level 10 m; in all other cases there was a considerable error. The lower the lidar was situated, the sooner did the zone of signal distortion appear. Appropriate expressions were derived which were experimentally checked in the Black Sea. Computations and in situ measurements revealed that the rereflection effect introduces a considerable contribution to the lidar signal and must therefore be taken into account in an investigation of atmospheric parameters. The influence of the described effects can be lessened by a decrease in the lidar angle of view and its placement at great heights. Figures 2; references: 2 Russian.  
[317-5303]

## OPTICAL STABILITY, ATMOSPHERIC TRANSPARENCY AND AEROSOL ABSORPTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 21, No 2, Feb 85 (manuscript received 7 Jun 83) pp 139-146

LIVSHITS, G. Sh., Kazakh Pedagogic Institute

[Abstract] The applicability of the classical Bouguer method for determining transparency and the criterion for stability of optical properties of the atmosphere proposed by V. G. Fesenkov and later developed by other authors require reexamination. Due to the influence of aerosol absorption the known stability test for a cloudless atmosphere is inadequate. Errors in determining the aerosol layer by the Bouguer method attain tens of percent due to aerosol absorption. Also examined are the results of a number of studies of pure aerosol absorption carried out in the laboratory and in situ. In particular, research was carried out using a photometric sphere whose walls diffusely reflect light (in conformity to Lambert's law), at whose center there is a uniform radiation source. It is assumed that the sphere is filled with natural aerosol. The experiments with this sphere made it possible to derive a formula which can serve as a basis for processing measurements of illumination of sphere walls before and after its filling with aerosol for the purpose of determining the aerosol absorption coefficient. The use of such a sphere filled with natural aerosol can be of exceptional use in local measurements. The formula is applicable in the case of weak attenuation of light and does not take into account the influence of absorption during multiple scattering. A determination of the components of the aerosol optical layer for the entire atmosphere, however, requires the development of new, improved methods. Figures 3; tables 1; references 14: 13 Russian, 1 Western.  
[317-5303]

UDC 551.596.1

## PROPAGATION OF ACOUSTIC PULSE IN ATMOSPHERIC WAVEGUIDE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 21, No 2, Feb 85 (manuscript received 31 Aug 83) pp 131-138

KULICHKOV, S. N., CHUNCHUZOV, I. P. and SHURYGIN, Ye. A., Atmospheric Physics Institute, USSR Academy of Sciences

[Abstract] A theoretical study was made of the anomalous propagation of an acoustic pulse of finite amplitude in the Epstein layer and a relationship was established between the parameters of such a pulse near the earth's surface and the parameters of the layer itself. Emphasis is on the influence of the nonlinear effects always prevailing when there are acoustic powers

of the source  $\sim 10^{11}$ - $10^{12}$ J. The problem is solved in two steps. In the first only the nonlinear transformation of the pulse is taken into account prior to capture in a waveguide. Then a linear solution is found for describing the wave field within the layer. Specific data are used from an experimental study of anomalous sound propagation. It is shown that the characteristic frequency of such a pulse is close to the central frequency of a nonlinearly distorted pulse at the altitude of its first reflection; with an increase in  $\Delta t$  the frequencies of the pulse spectral components slowly increase; the initial part of the pulse is most stable in shape. There is a qualitative agreement between the theoretical and experimental results. Although the selected model of atmospheric stratification does not take into account the influence of the wind and other factors, nevertheless it makes it possible to explain some characteristics of the anomalous propagation of acoustic pulses in the real atmosphere. Figures 3; references: 7 Russian. [317-5303]

UDC 551.513.1

#### APPROXIMATE METHOD FOR COMPUTING WIND VELOCITY IN ATMOSPHERE

Minsk VESTSI AKADEMII NAVUK BSSR: SERYYA FIZIKA-MATEMATYCHNYKH NAVUK  
in Russian No 1, Jan-Feb 85 (manuscript received 14 Dec 82) pp 25-29

ZHURBILO, L. A. and TSVETKOV, V. I., Gomel Division, Mathematics Institute,  
Belorussian Academy of Sciences

[Abstract] Approximate formulas are derived for computing the components of the wind velocity vector in the atmosphere, including the vertical component. The derived formulas are used in numerical experiments for computing the components of the velocity vector. Data on geopotential for the northern hemisphere for the period 1970-1975 were used as a basis in these experiments. Pressure and temperature were computed for four altitudes: 2 m, 5,400 m, 8,950 m, 15,850 m. The results are represented graphically, with the following plotted: zonal velocity, meridional velocity, vertical velocity. The first graphic shows that at the level of the ground there are three zones with a latitudinal wind velocity component. In the low latitudes there is a predominance of the easterly wind velocity component--tropical easterly transfer. In the middle latitudes the westerly component dominates--westerly transfer. The region of the jet stream with a center at an altitude of 10 km and a latitude of about  $30^\circ\text{N}$  shows up clearly. The graphics of the fields of the meridional and vertical wind velocities reveal qualitative and quantitative agreement with data for the real atmosphere; there are three principal circulation cells: direct in the low latitudes, retrograde in the middle latitudes and again direct in the high latitudes, in good agreement with meridional atmospheric circulation for winter. The algorithm presented in the article qualitatively and quantitatively reproduces the main characteristics of atmospheric circulation and is of value for analyzing the state of the real atmosphere. Figures 1; references: 7 Russian. [274-5303]

## CLEARING OF POLYDISPERSE AQUEOUS AEROSOL BY LASER RADIATION PULSES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 3, Mar 85  
(manuscript received 2 Dec 83) pp 377-383

PUSTOVALOV, V. K. and KHORUNZHIY, I. A.

[Abstract] The clearing of an aqueous aerosol by laser radiation pulses has been studied only experimentally; the theoretical examination presented here therefore fills an important gap. A system of equations is derived which is used for studying the propagation of pulses of laser radiation with a wavelength  $\lambda = 10.6 \mu\text{m}$  in a polydisperse aqueous aerosol. The results of numerical computations of the clearing process are presented. For example, a pulsed regime of aerosol modification is characterized by the development of processes of intensive heating and evaporation of droplets during the duration of the pulse.  $T_{\text{max}}$  can be attained during any stage of the pulse as a function of  $E$ ,  $t_{\text{pulse}}$ , pulse shape and other parameters. In the intervals between pulses there is no (or virtually no) evaporation of droplets due to accumulated thermal energy and propagation of the clearing wave virtually ceases. A decrease in  $t_{\text{pulse}}$  with constant  $E$  results in an increase in the density of the energy flux  $I$ , a conspicuous acceleration of the processes of evaporation and clearing of aerosol. This is attributable to the heating of droplets to higher temperatures and their evaporation in energetically advantageous temperature intervals in which there is a substantial decrease in energy losses on the heating of the surrounding air due to thermal conductivity. These and many other findings are compared with the process of clearing under the influence of continuous radiation for the purpose of ascertaining the optimum regime of the aerosol clearing process. It was found that the rate of clearing of aerosol under the influence of pulsed radiation is somewhat greater than the rate of clearing of aerosol under the influence of continuous radiation. Figures 3; references: 5 Russian. [330-5303]

UDC 621.396.96+551.511

## RADIO WAVE SCATTERING AND TURBULENCE INTERMITTENCE IN ATMOSPHERE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 28, No 2, Feb-Mar 1985 (manuscript received 21 May 84) pp 242-244

GURVICH, A. S., Atmospheric Physics Institute, USSR Academy of Sciences

[Abstract] A model of turbulent fluctuations of the atmospheric refractive index which takes intermittence into account is proposed applicable to study of radio wave scattering and fluctuations in the scattered wave are examined. With a sufficiently great scattering volume there are both rapid fluctuations of the energy flux density  $S$  as a result of interference of waves scattered

by individual sectors of the volume and slow fluctuations of  $S$  as a result of intermittence (random variations of turbulence intensity in the scattering volume). An effort is made to arrive at a measure of the intensity of turbulence in a volume at a particular moment in time. Allowance is made for the known fact that the spatial spectrum of turbulent fluctuations of the refractive index (on which atmospheric scattering is dependent) is determined by the rate of dissipation of the kinetic energy of turbulence and the rate of evening-out of nonuniformities of the refractive index. It is also known that intermittence can cause some change of the exponent in the refractive index spectrum. With such factors taken into account it was possible to arrive at a specific measure for turbulence intensity in the scattering volume. The probability that the  $S$  parameter will exceed some stipulated value was investigated. A table gives the  $P$  values for specific values of a number of pertinent variable factors. The findings from this research indicate that radar signal fluctuations can be used in studying the intermittence of atmospheric turbulence. Tables 1; references 9: 5 Russian, 4 Western.

[306-5303]



UDC 55+552.16(99)

CONDITIONS FOR FORMATION OF PARAGENESES CONTAINING KYANITE-ORTHOCLASE IN  
REGION OF MOUNT PROVENDER AND PRATT PEAK (SHACKLETON RANGE, ANTARCTICA)

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 281, No 5, Apr 85  
(manuscript received 24 Jul 84) pp 1188-1191

SEMENOV, V. S., All-Union Geology of Mineral Resources of World Ocean  
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[Abstract] Metamorphic formations arising under conditions of a kyanite-garnet-biotite-orthoclase subfacies of the almandine-amphibolite high-pressure facies are rare throughout the world. This article describes the first finds of such metamorphic rocks in Antarctica. The gneisses and crystalline schists containing kyanite and orthoclase are regarded as of interest because they were formed under conditions of extremal pressures and temperatures and with a rather unusual composition of the fluid solutions, characterized by a high content of hydrocarbons relative to the remaining components. Three independent methods (described in the Russian literature) were used in ascertaining the conditions for formation of these rocks exposed in the Shackleton Range. Three types of inclusions (melt, gas-fluid and gas) in the minerals of these rocks are discussed. The evidence indicates that the kyanite-orthoclase gneisses and crystalline schists found in the neighborhood of Mount Provender-Pratt Peak in the Shackleton Range were formed at pressures not less than 9-11 kbar and temperatures not less than 740°C. An analysis of the ratio of the rock minerals and their chemical composition made it possible to trace the evolution of crystallization in these parageneses and determine the nature of development of the geothermal regime of metamorphism. The nature of evolution of the deep petrogenesis regimes is characteristic of eugeosynclinal zones of ancient geosynclines or protogeosynclinal systems. Figures 1; tables 1; references: 3 Russian.  
[348-5303]

## USE OF 'OMEGA' RADIO NAVIGATION SYSTEM IN GEOPHYSICAL WORK IN ANTARCTICA

Moscow EKSPRESS-INFORMATSIYA. SERIYA: MORSKAYA GEOLOGIYA I GEOFIZIKA  
in Russian No 4, 1985 pp 3-7

KALINSKIY, S. I., All-Union Marine Geology Scientific Research Institute;  
Sevmorgeologiya Geological Production Association

[Abstract] Antarctic flights are hampered by a complete absence of navigational support in that region. It is necessary to use global radio navigation systems, such as the "Omega" microwave radio navigation system, whose eight stations are in Norway (A), Liberia (B), South Dakota (D), Reunion (E), Hawaii (C), Argentina (F), Australia (G) and Japan (H). The matter of propagation of microwave waves over the Antarctic continent has been poorly studied and therefore no use should be made of those stations whose paths intersect the continent. Accordingly, in selecting the optimum combinations of pairs of stations an effort must be made to ensure that the position angles are in the range  $50^\circ < W_{1,2} < 150^\circ$  (then the geometry factor will be  $\Gamma \leq 2$ ). The author recommends the best combination: of pairs of "Omega" stations for latitude  $70^\circ\text{S}$  in six longitude zones (Nos 19, 20, 21, 22, 23, 24). For example, for zone 22 ( $120^\circ\text{--}180^\circ\text{W}$ ) these would be Hawaii (C)-Australia (G) and Hawaii (C)-Argentina (F). In each of the six considered zones it is recommended that three "Omega" stations be used, this ensuring a minimum of two position lines. In certain cases, with favorable conditions for the reception of microwave waves and with good angles of intersection of position lines, it is possible to obtain a third position line as well, which would increase accuracy in position determination by 20-25%. During navigation in Antarctic seas it is possible to receive signals from stations more than 10,000 km distant and this ensures a possibility of increasing accuracy in position determination by obtaining extra position lines. Figures 3; tables 1.

[334-5303]

UDC 551.24:553.06.3

## HIGHLY IMPORTANT FEATURES OF REGIONAL TECTONICS OF EARTH'S ARCTIC SECTOR

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA  
in Russian No 1, Jan 85 pp 3-7

GAVRILOV, V. P., Ministry of the Chemical and Gas Industry  
imeni I. M. Gubkin

[Abstract] The existence of several circumarctic subconcentric tectonic zones inscribed in one another is a highly important feature of the regional tectonics of the arctic sector. Three such zones can be discriminated: outer (Precambrian), middle (Paleozoic) and inner (Cenozoic).

The circum-Pacific Ocean tectonic belt in turn consists of two zones: outer (Mesozoic) and inner (Cenozoic). A figure accompanying the text is a map showing these zones and such features as rift valleys, graben-rifts and basement blocks. A separate paragraph is devoted to description of each of these zones. The following are the most important features characteristic of the arctic segment with respect to the regional tectonic plan: zonal subconcentric positioning of regions of different age; presence of Baykal blocks of different age in the structure of the younger zones; spatial overlapping of circum-Pacific Ocean zones on the circumarctic tectonic zones. All three features are a consequence of the multistage geological history of development of the region. The arctic sector is characterized by extensive development of fault tectonics and therefore a great fracturing of the earth's crust. The extensive spatial development of graben-rifts is a noteworthy features of the fault tectonics in this region. Particular attention is given to the differences between rifts and faults. A noteworthy feature is the concentration of graben-rifts on the shelf and in adjacent regions of the land, indicative of active processes of destruction of these sectors of the lithosphere. The graben-rifts are grouped into system oriented in submeridional and sublatitudinal directions. Figures 1; references: 3 Russian.  
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